Final version: 2017/02/10

The Mathematical Society of Japan

2017 Annual Meeting

Titles and Short Summaries of the Talks

March, 2017

at Tokyo Metropolitan University

Final version: 2017/02/10

2017 The Mathematical Society of Japan

ANNUAL MEETING

Dates: March 24th (Fri)–27th (Mon), 2017

Venue: Tokyo Metropolitan University
1-1 Minami-Osawa, Hachioji-shi, Tokyo 192-0397

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	I Small Hall Auditorium	II Bldg. 11 Rm. 204	III Bldg. 11 Rm. 110	IV Bldg. 12 Rm. 101	V Bldg. 12 Rm. 102	VI Bldg. 12 Rm. 103	VII Bldg. 12 Rm. 104	VIII Bldg. 12 Rm. 201	IX Bldg. 12 Rm. 202
24th (Fri)	Functional Equations 9:30–12:00 14:15–16:15	Algebra 9:30–11:45 14:25–17:00	Found. of Math. and History of Math. 9:00–11:30 14:15–16:40	Topology 10:00–12:00 15:30–17:00	Applied Mathematics 10:30–11:45 14:15–15:30	Statistics and Probability 9:45–12:00	Complex Analysis 9:30–11:50 14:15–16:05	Geometry 9:45–11:45 14:15–16:10	Functional Analysis 14:15–16:00
	Featured Invited Talks 13:00–14:00								
	Invited Talk 16:30–17:30			Invited Talk 14:15–15:15	Invited Talk 15:50–16:50	Invited Talks 14:15–15:15 15:30–16:30	Invited Talk 16:20–17:20	Invited Talk 16:20–17:20	Invited Talk 16:15–17:15
25th (Sat)	Functional Equations 9:30–12:00	Algebra 9:00–12:00	Found. of Math. and History of Math. 9:15–11:30	Topology 10:00–11:50 13:15–14:45	Applied Mathematics 10:00–11:45	Statistics and Probability 9:50–11:30 13:30–14:30	Complex Analysis 9:40–11:50	Geometry 9:20–11:30	Functional Analysis 9:00–12:00
	Invited Talk 13:30–14:30	Invited Talk 13:30–14:30	Invited Talk 13:15–14:15				Invited Talk 13:15–14:15	Invited Talk 13:15–14:15	Invited Talk 13:15–14:15
	MSJ Prizes Presentation (Large Hall, Auditorium) ····· (15:00–15:20) Plenary Talks (Large Hall, Auditorium) MSJ Spring Prize Winner ····· (15:30–16:30) Toshiaki Shoji (Tongji Univ.) ····· (16:40–17:40) Official Party (Lever son Verre "Minami-Osawa") ····· (18:00–20:00)								
26th (Sun)	Functional Equations 9:30–12:00 14:15–16:15	Algebra 9:15–12:00	Infinite Analysis 10:30–11:30	Topology 10:00–12:00 14:15–15:45	Applied Mathematics 14:15–16:30 Special Session 9:30–12:00	Statistics and Probability 9:50–12:00	Real Analysis 9:00–11:55 14:15–16:50	Geometry 9:50–11:40 14:15–15:35	Functional Analysis 9:30–12:00 14:15–16:15
	Featured Invited Talks 13:00–14:00								
	Invited Talk 16:30–17:30	Invited Talks 14:30–15:30 15:40–16:40 16:50–17:50	Invited Talks 14:15–15:15 15:30–16:30	Invited Talk 16:00–17:00	Invited Talk 16:50–17:50	Invited Talks 14:15–15:15 15:30–16:30	Invited Talk 17:00–18:00	Invited Talk 15:50–16:50	Invited Talk 16:30–17:30
27th (Mon)	Functional Equations 9:15–12:00 14:15–16:15	Algebra 9:15–12:00 14:15–16:00	Infinite Analysis 10:15–12:00		Applied Mathematics 9:30–11:30 14:15–16:20	Statistics and Probability 9:50–12:00	Real Analysis 9:00–11:40 14:15–16:25		
	Featured Invited Talks 13:00–14:00								
	Invited Talk 16:30–17:30				Invited Talk 16:40–17:40		Invited Talk 16:40–17:40		

Contents

Plenary Talks

March 25th (Sat) Large Hall, Auditorium

2017 Spring Prize Winner ..... (15:30–16:30)

Toshiaki Shoji (Tongji Univ.) Kostka functions associated to complex reflection groups .. (16:40–17:40)

Summary: Kostka polynomials $K_{\lambda,\mu}(t)$ are well-known objects in the combinatorial theory, which are polynomials indexed by a pair of partitions λ, μ of n. They are closely related to the representation theory of the symmetric group S_n of degree n. Kostka polynomials also have an interesting relationship with the geometry of the general linear group $GL(V)$, where V is an n-dimensional vector space over the complex number field. In 1981, Lusztig gave a geometric interpretation of Kostka polynomials in terms of the intersection cohomology associated to the nilpotent orbits for $GL(V)$.

An r-tuple of partitions is called an r-partition. In 2001, as a generalization of Kostka polynomials, r-Kostka functions were introduced in a combinatorial way. They are (a-priori) rational functions indexed by a pair of r-partitions of n, and also called Kostka functions associated to complex reflection groups since they have a close relationship with the representation theory of the complex reflection group $G(r, 1, n)$, which is a generalization of the Weyl group of type C_n. Recently an interesting relationship between those r-Kostka functions and the geometry of the enhanced variety $GL(V) \times V^{r-1}$ or of the exotic symmetric space $GL(V)/Sp(V) \times V^{r-1}$ was found. In this talk, we give an exposition on those topics concerning with r-Kostka functions.

Featured Invited Talks

March 24th (Fri)

Conference Room II

Takeshi Tsuji (Univ. of Tokyo) The p-adic Simpson correspondence ····· (13:00–14:00)

Summary: I will survey the p-adic Simpson correspondence, which aims at describing $\mathbb{C}_p$-representations of the geometric algebraic fundamental group of a proper non-singular algebraic variety over a p-adic field in terms of Higgs bundles, as an analogue of the work of C. Simpson for a complex variety. I will talk mainly on the most advanced and general approach to the theory which was introduced by G. Faltings around 10 years ago, and has been studied systematically by two new methods, one by A. Abbes and M. Gros and the other by myself. Both have analogues in the non-abelian Hodge theory in characteristic p initiated by A. Ogus and V. Vologodsky also around 10 years ago, which I will briefly mention. I will start by reviewing some related preceding works in p-adic Hodge theory.

Conference Room III

Toshimichi Usuba (Waseda Univ.) Universe of set theory —the Universe and Multiverse— ··· (13:00–14:00)

Summary: By Cohen's forcing method, it was turned out that many classical mathematical problems, such as the Continuum Hypothesis, are independent from ZFC. Forcing is a general and flexible method to construct extensions of "Universe" of set theory, a class of *all* sets. Now we can construct various universes by forcing method, for instance, we can take two universes, one of which satisfies the Continuum Hypothesis, and another does not.

Recently, a concept of Multiverse, a collection of universes of set-theory, is introduced. Multiverse can be seen as a collection of *all* possible mathematical worlds. In this talk, I will survey the study of Multiverse, and discuss what is "independent" from ZFC.

March 26th (Sun)

Conference Room V

Guest Talk from the Japan Society for Industrial and Applied Mathematics

Hideyuki Azegami (Nagoya Univ.) Regularized solutions to shape optimization problems and their applications ····· (13:00–14:00)

Summary: Optimization of a shape by performing 'free' perturbations of its boundary is called a shape optimization problem. Meanwhile, optimizing a shape by acting on its topology is called topology optimization problem. These problems are common in engineering sciences. In this talk, we consider PDE constrained shape/topology optimization problems, and illustrate how to reformulate such problems into functional optimization problems and examine their solutions. In the process of finding solutions of these types of problems, some regularity issues may arise. In some cases, for instance, the Fréchet derivatives of cost functions with respect to design variables do not have the regularities required for the admissible sets of design variables. To get around this difficulty, we propose numerical solutions by using a gradient method and a Newton method in function spaces of H^1 class. These methods are applicable not only to product design but also to various actual problems.

Conference Room VII

Yoshihiro Mizuta (Hiroshima Univ.*) Function spaces with variable exponents ..... (13:00–14:00)

Summary: As a generalization of the classical Lebesgue L^p space, by replacing a constant exponent p with a variable exponent $p(x)$, a variable Lebesgue space is constructed, which is called the Lebesgue space with the variable exponent $p(\cdot)$.
The Lebesgue spaces with variable exponents were introduced by W. Orlicz and H. Nakano in the early 1930s, and then became the renewed interest since the early 1990s by O. Kováčik, J. Rákosník, M. Růžička, and others. They were extremely developed in 2000s after the celebrated work by L. Diening.
Fundamental properties appear in the book by L. Diening, P. Harjulehto, P. Hästö, and M. Růžička, and the book by D. Cruz-Uribe and A. Fiorenza.
In this talk, the theory of the Hardy–Littlewood maximal operator is developed in the variable settings, and, as an application, the variable Sobolev theorem is established for Riesz potentials and Sobolev functions.

Conference Room VIII

Mikio Furuta (Univ. of Tokyo) An introduction to mathematical aspect of topological phase and bulk-edge correspondence ..... (13:00–14:00)

Summary: In material sciences, some phenomena which are "related to topology" have been attracting a great deal of attention for more than 10 years. In 2016 the Nobel prize in physics was given to three researchers who conducted pioneering works in this area. "Related to topology" means that the quantities (or "orders") characterizing some states or phases are preserved even if parameters of the settings change continuously. The quantities are typically/often described by certain characteristic classes of vector bundles, or some version of K-group. We would like to explain some mathematical aspect of "topological phase", in particular "bulk-edge correspondence", under the (strong) assumption that the system is without interaction.

March 27th (Mon)

Conference Room III

Atsuo Kuniba (Univ. of Tokyo) Matrix products in integrable probability ..... (13:00–14:00)

Summary: Quantum groups and theory of quantum integrable systems provide efficient algebraic and analytic tools to evaluate non-equilibrium characteristics in stochastic processes in statistical mechanics. In this talk I shall focus on the stationary states of a class of Markov process of particles on one-dimensional lattice and describe their integrable structures inherent in the matrix product method. It will encompasses multi-species exclusion/zero-range processes, tetrahedron and Yang–Baxter equations, Ferrai–Martin type algorithm, matrix product formulas of quantum R matrices and stationary probabilities, Zamolodchikov–Faddeev algebra, generalization of Macdonald polynomials and so forth.

Conference Room V

Hiroshi Suito (Okayama Univ.) Mathematical sciences for understanding the mechanisms of cardiovascular diseases ..... (13:00–14:00)

Summary: This talk presents our ongoing efforts under the "New challenges for mathematical modeling in clinical medicine" project supported by JST in the CREST framework. This research project is aimed at contributing to our society through applications of mathematical modeling to clinical medicine. Our targets include diverse approaches such as ascertaining the mechanisms of various diseases using high-quality numerical simulations based on partial differential equations, extracting algorithms from accumulated experiences of skilled medical doctors, and using various statistical approaches, machine learning strategies, and high-performance medical image processing techniques. Up-to-date mathematical concepts and methodologies can play crucial roles supporting clinical medicine. These challenging goals can be achieved through close collaboration between mathematicians and clinical doctors.

Foundation of Mathematics and History of Mathematics

March 24th (Fri) Conference Room Ⅲ

9:00–11:30

1 Shigeru Masuda (Res. Workshop of Classical Fluid Dynamics) — The essential concept in a study of the mathematical physics by Laplace, Gauss and Poisson ····· 15

Summary: We discuss the essential concept in a study of the mathematical physics by the mathematical physicists, in which they base on the newly-coming continuum theory of the action of attractive and repulsive forces. In the case of Poisson, he stands on the theory of the hydrodynamics in 1829, and which consist a common concept among the hydrodynamics, hydrostatics in 1831 and heat theory in 1835. This concept is traditionally accepted by Laplace and Gauss, however, the method to recognize and solve the applied problems of the capillary action or the heat are different in each other. We discuss the differences among them.

2 Shigeru Masuda (Res. Workshop of Classical Fluid Dynamics) — The mathematical newness of the new theory of the capillary action by Poisson ····· 15

Summary: Poisson compares the each equation dues to the theory of the capillary action by Laplace and Gauss with his. Poisson comments in the preface about Gauss' paper 1830 : 1) Gauss' success is due to the merit of his 'characteristic'. 2) Even Gauss uses the same method as the given physics by Laplace. 3) Gauss calculates by the condition only the same density and incompressibility. After all, Poisson insists that we can take even any method to solve the problem, and carefully check our own equations and conditions from every points. Finally, he makes the new theory of the capillary action. We discuss these points from the viewpoint of the hydrodynamics, including the hydrostatics and the heat theory. Poisson uses the word 'fluidity' which is common concept among the hydrodyanmics, hydrostatics and heat theory. Here is, we think, one of his newness of this book.

3 Noriko Tanaka (Toyota Nishi High School) — An autobiographical note by Paul Lévy ····· 15

Summary: Paul Lévy left the abundant and deep works in probability. Prof. Dr. Takeyuki Hida who built the white noise theory was influenced by Paul Lévy. I would like to read the letters between Prof. Dr. Hida and Paul Lévy and introduce Prof. Dr. Lévy's nature.

4 Michiyo Nakane — Joseph Fourier's course of analysis and his algebraic analysis ····· 15

Summary: In 1795–1796 Fourier provided a course of analysis in Ecole Polytechnique. His lectures began with a unit entitled in "algebraic analysis". Following to him, Lacroix and Cauchy adopted this name to their preparation classes for analysis. This paper examines Fourier's lecture notes published in 1989 and shows the contents of the unit: solutions of algebraic equations and theories of infinite series. Also, we discuss why he gave such a name to his introductory classes.

5 Tanaka Shotaro ♭ Representations of $(3k-2)^q$, $\Sigma^n(3k-2)^q$ & $\Sigma^\infty(3k-2)^q x^{k-1}$ by Suida 15

Summary: Def. $d_p(k) \equiv (p+k-1)!/p!(k-1)! = (1/p!)k(k+1)(k+2)\cdots(k+p-1)$, p-th. order, k-th. Formulae (A): $d_1(k)d_p(k-\alpha) = (1+\alpha)d_{p+1}(k-\alpha) + (p-\alpha)d_{p+1}(k-\alpha-1)$, integer $\alpha \geqq 0$. (A-1): $d_1(k)d_p(k) = d_{p+1}(k) + pd_{p+1}(k-1)$. (A-2): $d_1(k)d_p(k) = (p+1)d_{p+1}(k) - pd_p(k)$. Examples by (A-1), $(3k-2)^2 = \{3d_1(k) - 2d_0(k)\}\{3d_1(k) - 2d_0(k)\} = d_2(k) + **+13d_2(k-1) + 4d_2(k-2)$. By (B-1) & (B-2), $\Sigma^n(3k-2)^2 = d_3(n)+13d_3(n-1)+4d_3(n-2)$. By Wada's theorem, $\Sigma^\infty(3k-2)^2x^{k-1} = (1+13x+4x^2)/(1-x)^3$.

6 Katsushi Waki (Yamagata Univ.) Takuma Tsuchihashi (Meiji Univ.) Construction of WASAN data base with graphic search capability 15

Summary: We will suggest a new WASAN data base which can search geometric problems. We also try to recognize construction methods of geometric problems. From this recognized information, we can search similar geometric problems.

7 Tsukane Ogawa (Yokkaichi Univ.) Mathematical philosophy of Aida Yasuaki 15

Summary: Aida Yasuaki (1747–1817) left several books which included mathematical and historical critiques on the mathematics of the day. His books are very valuable and useful for us to study the mathematical philosophy in pre-modern Japan, for there are few such books. I pay attention here to his "Sanpou Kokon Tsuuran" (Survey of Mathematical Methods Old and New) and consider his mathematical philosophy.

8 Mitsuo Morimoto (Yokkaichi Univ. / Sophia Univ.⋆) On Volume 12 of the Taisei Sankei and the Tetsujutsu Sankei 15

Summary: I shall discuss the relation between Volume 12 of the Taisei Sankei (1711) and the Tetsujutsu Sankei (1722). Both treatises treat the numerical calculation of π done by Takebe Katahiro (1664–1739), who improved drastically the calculation done by Seki Takakazu (ca. 1642–1708) during 1711–1722. (I prepared this talk for the meeting of September 2016 but I could not attend it because of my sickness.)

9 Makoto Tamura (Osaka Sangyo Univ.) On the order of problems of the "Shu" housed at Yuelu Academy 15

Summary: We rearranged the order of problems of the "Shu" housed at Yuelu Academy in our book on the "Shu." Yuelu Academy has arranged its problems according to the order of "JiuShu." However, since there are the other unearthed books belonging to the same period of time, the "Suanshushu" and the "Shanshu," we should refer to them rather than "JiuShu." In our order, "Shaoguang" is in the beginning of the book and the strip with the title of the book on its back is the last one.

11:30–12:00 Mathematics History Team Meeting

14:15–16:40

10 Shuhei Masumoto (Univ. of Tokyo) On a generalized Fraïssé limit construction 15

Summary: In this talk, we introduce a variant of Fraïssé limit construction for metric structures. This construction deals with a category of finitely generated metric structures which satisfies the hereditary property, the joint embedding property, the near amalgamation property, the weak Polish property, and the Cauchy continuity property. We also present an application to operator algebras.

Summary: König's lemma is one of the most famous examples of combinatorial theorems which are computably false. On the other hand, it is well-known that any infinite computable tree $T \subseteq 2^{<\omega}$ which has at most finitely many paths has a computable path. Then, how can we understand this in the context of reverse mathematics? Is it provable within RCA_0? We will see that some variations of this type of statements imply non-trivial induction.

Summary: We study the number of independent strict orders. We do not assume the condition of NIP.

Summary: Let T be a 1st order complete theory. Then a non-isolated type $p \in S(T)$ is said to be special, if there are $a, b \models p$ such that $\mathrm{tp}(b/a)$ is isolated and $\mathrm{tp}(a/b)$ is non-isolated. It can be seen that if there is a counter-example of the Lachlan conjecture, the theory has a special type. We consider the following question: Is there a small stable theory with special type? In this talk, we want to give some results on the question.

Summary: Evans, Gardernezhad, and Tent proved that the automorphism group of the generic structure of $\mathbf{K}_f$ is simple if it has a property called the monodimensionality. They proved this property for the case that the coefficient of the dimension function is 1/2. We proved that it is also the case if the coefficient of the dimension function is a rational number between 1/2 and 1. It is likely that the monodimensionality also holds if the coefficient is a rational number between 0 and 1/2.

Summary: In the context of ZFC (Zermelo–Fraenkel Set Theory with the Axiom of Choice), most large cardinals are much bigger than small infinite cardinals such as ω and ω_1. However, if one works in ZF without the Axiom of Choice, it is known that some large cardinals could be the same as ω_1. For example, Jech and Takeuti independently showed that ω_1 could be a measurable cardinal in ZF assuming the consistency of ZFC + "There is a measurable cardinal". Takeuti also showed that ω_1 could be a supercompact cardinal in ZF assuming the consistency of ZFC + "There is a supercompact cardinal". In this talk, we discuss some consequences of the theory ZF + "ω_1 is a supercompact cardinal". This is joint work with Nam Trang.

Summary: We discuss possible order-types of uncountable linearly ordered structures from the point of view of the five element basis.

17 Sakaé Fuchino (Kobe Univ.) Reflection theorems on non-exisitence of orthonormal bases of pre-Hilbert spaces 15

Summary: We prove that the reflection of the non-existence of orthonormal bases of a pre-Hilbert space down to many subspaces of density less than $\aleph_2$ is equivalent to the Fodor-type Reflection Principle. For one direction of the equivalence proof we use the Singular Compactness Theorem for pre-Hilbert spaces of singular density without orthonormal bases. We shall also discuss some other related problems.

18 Masanao Ozawa (Nagoya Univ.) Conditional in quantum logic and Takeuti's quantum set theory: Conditionals satisfying the quantum transfer principle 15

Summary: There is a well-known difficulty in choosing a binary operation for conditional in quantum logic. Here, we consider the problem as to what binary operation on the quantum logic Q, if it is used for the interpretation of conditional, allows the Quantum Transfer Principle for Takeuti's model $V^{(Q)}$ of quantum set theory asserting that *for every* Δ_0*-formula* $\phi(x_1,\dots,x_n)$ *provable in ZFC satisfies the relation*

$$[\![\phi(u_1,\dots,u_n)]\!] \geq \mathrm{com}(u_1,\dots,u_n)$$

for all $u_1,\dots,u_n \in V^{(Q)}$, where com stands for the commutator of elements of $V^{(Q)}$. We determine all the polynomially definable binary operations $\to$ on Q such that the model $V^{(Q)}$ satisfies the Quantum Transfer Principle if the operation $\to$ is used for interpreting conditional.

March 25th (Sat) Conference Room III

9:15–11:30

19 Takashi Oyabu ♭ Representation, and other 5 talks 5

Summary: 1. Representation: Representation of the compact Lie Group: Peter–Weyl Theory: G==G': Homotopy equivalent====>G==G': Isomorphic:

2. ZF=====>R: Axiomatic set theory: number:: number system: ZF−UNIVERSE++AC++V===L: ⊃ TOTAL Mathematics: K[X]: K[[X]]: R{X}::R[[X]]C[X]::C[{X}] We have GEOMETRY:

3. Differential Equation: NEW method of showing the existence of the solution of O.D.E. is presented: Theory of H-THEOREMS: H=∫dAUlogU: U>0:: dH/dt=<0==>0:

4. Riemann SURFACE: R=SnXSL2(Z)\SL2(R)/SO(2): H=SL2(R)/SO(2): AUT(H)=SL2(R)⊃G Algebraic Functions; K(V) ↪=K(V):

5. Group · Ring · Field: G==G': Homotopy equivalent: R==R': Homotopy equivalent::??? F==F': Diffeomorphic:?????: Geometric thoughts are preented;:

6. Modern science: Mathematics: Physics: Chemistry: Biology:: Modern science: are discussed

Summary: It is well-known that Turing degree of the halting problem splits into two 1-generic degrees. Wu (2006) extends this result. He shows that every nonzero computably enumerable degree splits into two 1-generic degrees. By relativizing Wu's proof via the Lachlan set, it is seen that every nonzero 2-c.e. degree splits into four 1-generic degrees. We give an alternative proof of this result. In our proof, we introduce the concepts of real stages and ostensible stages, and rollback of ostensible stages. We also put some remarks on some stronger results shown in Wang (2011) and Chong–Yu (2016).

Summary: In the theory of algorithmic randomness, as an application field of computability theory, separation between two randomness notions is a central topic. In particular, separation between Schnorr randomness and computable randomness was a difficult problem and solved only relatively recently. In this talk I will show the separation between Schnorr randomness and computable randomness in Medvedev degrees.

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. The alternative rule is about quantum measurements with finite outcomes. In this talk, we show that this work can be naturally extended over quantum measurements with countably infinite outcomes.

Summary: We have obtained so far a neat correspondence between distributive concrete domains well-known as models of higher-order sequentiality and sheaves endowed with a certain property of finiteness. Based on this result, we focus on sheaf-theoretical counterpart of arrows among distributive concrete domains, also known as sequential algorithms, for which we show that the device of a sequential algorithm can be decomposed into a sheaf homomorphism and a functor representing internal structure of the computation.

Summary: Let Γ be a class of formulas. We say that a theory T in classical logic has the Γ-disjunction property if for any Γ sentences φ and ψ, either $T \vdash \varphi$ or $T \vdash \psi$ whenever $T \vdash \varphi \vee \psi$. We investigate relationships between partial disjunction properties and several other properties of theories containing Peano Arithmetic.

Summary: Provability logic is a research area to investigate the properties of provability predicates in formal theories of arithmetic. The most important result in this area is Solovay's arithmetical completeness theorem of **GL**. To investigate proof predicates, Artemov introduced an operational system called the Logic of Proofs (**LP**). Instead of modality, **LP** deals with proof terms and formulae of the form $t : F$ where t is a proof term. Artemov also proved the arithmetical completeness theorem of **LP**. We prove an extended version of Artemov's arithmetical completeness theorem and the uniform arithmetical completeness theorem of **LP**.

Summary: Associativity (of fusion) is regarded as one of the important structural rules. Recently, some studies on non-associative substructural logics have been developed. In this talk, we show that some non-associative substructural logics have Craig's interpolation property using a modified Maehara's method.

Summary: The omniscience principles—sometimes known as non-constructive principles—discussed in constructive mathematics are principles which enlarge the concept of constructivity. We introduce axiom-schematic counterparts of some omniscience principles dealt with constructive arithmetic. These axiom schemata are not provable in intuitionistic predicate logic. When we add one of them to intuitionistic logic, we obtain an intermediate predicate logic, which has interesting properties from the viewpoint of intermediate predicate logics. Such observations must provide us with a research project interdisciplinary between constructive mathematics and intermediate logics.

11:30–12:00 Research Section Assembly

13:15–14:15 Talk Invited by Section on Foundation and History of Mathematics

Akitoshi Kawamura (Univ. of Tokyo) Computational complexity in analysis

Summary: Complexity theory measures the inherent hardness of computational problems by counting the number of discrete (symbolic) steps needed to solve them. Despite such discrete nature, it has recently been applied successfully to various problems involving real numbers, real-valued functions and other objects of interest in mathematical analysis. This is done by representing the objects in a way suitable for the structure of approximation that we have in mind for the computational tasks in question. This talk will introduce some of the basic concepts and recent developments in this field.

Algebra

March 24th (Fri) Conference Room II

9:30–11:45

1 Shigeru Iitaka (Gakushuin Univ.*) On Euler's perfect numbers ····· 10

Summary: Here, we introduce Euler's perfect numbers. Let P be a prime. For given e and m,if $\varphi(P^e)+1+m$ is a prime q, then $a = P^e q$ is called Euler's $(*)$ perfect number.

2 Daisuke Shiomi (Yamagata Univ.)
Hidetaka Kitayama (Wakayama Univ.) Irreducible Fibonacci polynomials and Lucas polynomials over finite fields ····· 10

Summary: In this talk, we give the necessary and sufficient condition that Fibonacci and Lucas polynomials are irreducible over finite fields.

3 Soichi Ikeda (Shibaura Inst. of Tech.)
Kaneaki Matsuoka (Nagoya Univ.) On the functional relations for Euler–Zagier multiple zeta-functions ·· 10

Summary: The purpose of this talk is to formulate the problem about existence or non-existence of functional relations for the Euler–Zagier multiple zeta-functions and solve this problem. This problem is a functional analogue of the problem about existence or non-existence of relations among the multiple zeta values. By our results, we can solve a functional analogue of the problem about the dimension of the $\mathbb{Q}$-vector space spanned by the multiple zeta values.

4 Makoto Minamide (Yamaguchi Univ.)
Jun Furuya
(Hamamatsu Univ. School of Medicine)
Yoshio Tanigawa On the functional equations for $\zeta(s)\zeta''(s)$ and $\zeta'(s)\zeta''(s)$ ····· 10

Summary: In our previous talk, we showed an improvement of the error term in the approximate functional equation for $\zeta'(s)^2$. Now, in the cases of $\zeta(s)\zeta''(s)$ and $\zeta'(s)\zeta''(s)$ we shall consider the approximate functional equations of them.

5 Wataru Takeda (Kyoto Univ.) Visible lattice points and the Extended Riemann Hypothesis ····· 15

Summary: Let $\mathcal{O}$ be algebraic integers ring of a number field K, and let $I(\mathcal{O})$ denote the set of ideals of $\mathcal{O}$. We say that the ordered m-tuple ideals $(\mathfrak{a}_1, \mathfrak{a}_2, \ldots, \mathfrak{a}_m) \in I(\mathcal{O})^m$ is visible from the origin, if $\mathfrak{a}_1 + \cdots + \mathfrak{a}_m = \mathcal{O}$. We consider the number of visible lattice points in $\{(\mathfrak{a}_1, \mathfrak{a}_2, \ldots, \mathfrak{a}_m) \in I(\mathcal{O})^m \mid \mathfrak{N}(\mathfrak{a}_i) \leq x\}$. We know that it is related to the Extended Riemann Hypothesis.

6 Shota Inoue (Nagoya Univ.) The Riesz mean of the Möbius function ····· 10

Summary: In this talk, we consider the summatory function $M(x)$ of Möbius function. Mertens hypothesis, i.e. $M(x) \leq \sqrt{x}$ is disproved by Odlyzko and te Riele. Furthermore it is believed that $M(x) \ll \sqrt{x}$ is false but no one succeeded in proving this estimate. We report that the corresponding estimate can be established for a certain weighted version of the summatory function.

7 Ade Irma Suriajaya (Nagoya Univ.) Hirotaka Akatsuka (Otaru Univ. of Commerce) Distribution of zeros of the first derivative of Dirichlet L-functions ··· 15

Summary: Yildirim classified zeros of the derivatives of Dirichlet L-functions associated with primitive Dirichlet characters, as trivial zeros, nontrivial zeros, and vagrant zeros. In this talk we show that we can remove the possibility of vagrant zeros for $L'(s,\chi)$ when the modulo is large. With this, we can improve asymptotic formulas for the number of zeros of $L'(s,\chi)$. Finally, we introduce an equivalence condition analogous to that of Speiser's for the generalized Riemann hypothesis, stated in terms of the distribution of zeros of $L'(s,\chi)$ when the modulo is large.

8 Tomomi Ozawa (Tohoku Univ.) Classical weight one Hilbert cusp forms in a Hida family ····· 15

Summary: Let F be a totally real field and p an odd prime. It is well-known that a specialization at any arithmetic point of weight at least two of a primitive p-ordinary Hida family of parallel weight Hilbert cusp forms defined over F is a classical Hilbert cusp form. However, this is not always the case for weight one specializations. Balasubramanyam, Ghate and Vatsal proved that such a family admits infinitely many classical weight one specializations if and only if it is of CM type. In this talk, I will describe how to give an explicit estimate on the number of classical weight one specializations of a non-CM primitive p-ordinary Hida family.

9 Kohta Gejima (Osaka Univ.) An explicit formula of the unramified Shintani functions for $(\mathbf{GSp}_4, \mathbf{GL}_2 \times_{\mathbf{GL}_1} \mathbf{GL}_2)$ ····· 15

Summary: Let F be a non-archimedean local field of characteristic zero. In this talk, we give an explicit formula of Shintani functions on $\mathbf{GSp}_4(F)$. This formula is a natural generalization of the explicit formula of Shintani functions on the split orthogonal group $\mathbf{SO}_5(F) \simeq \mathbf{PGSp}_4(F)$ given by Kato–Murase–Sugano. As an application, we evaluate a local zeta integral of Murase–Sugano type, which turns out to be the spin L-factor of $\mathbf{GSp}_4$.

14:25–17:00

10 Toru Komatsu (Tokyo Univ. of Sci.) Yasuhiro Kishi (Aichi Univ. of Edu.) On a family of imaginary quadratic fields whose ideal class groups have 3-rank at least three ····· 15

Summary: In this talk, we prove that the 3-rank of the ideal class group of the imaginary quadratic field $\mathbb{Q}(\sqrt{4-3^{18n+3}})$ is at least 3 for every positive integer n.

11 Akiko Ito (Kanagawa Univ.)[b] On the divisibility of the class numbers of imaginary quadratic fields $\mathbb{Q}(\sqrt{2^{2s}3^{2t}-k^n})$ ····· 10

Summary: Let k be an odd positive integer with $3 \nmid k$ and let n, s, t be positive integers with $2^{2s}3^{2t} < k^n$. Using some properties of the primitive divisors of Lehmer numbers, we show that the class numbers of imaginary quadratic fields $\mathbb{Q}(\sqrt{2^{2s}3^{2t}-k^n})$ are divisible by n if k, n, s, t satisfy $k^{n/3} \neq 3^{2t-3} \pm 2^{s+1}$, $2^{2s+2}3^{2t-3} \pm 1$ and $\mathbb{Q}(\sqrt{2^{2s}3^{2t}-k^n}) \neq \mathbb{Q}(\sqrt{-1})$. This result is similar to the results of Y. Kishi and Z. Minhui–W. Tingting.

12 Ryojun Ito (Chiba Univ.) The Beilinson conjectures for CM elliptic curves via hypergeometric functions · 15

Summary: We consider certain CM elliptic curves which are related to Fermat curves, and express the values of L-functions at $s = 2$ in terms of special values of generalized hypergeometric functions. We compare them and a similar result of Rogers–Zudilin with Otsubo's regulator formulas, and give a new proof of the Beilinson conjectures originally due to Bloch.

13 Yoshiyasu Ozeki (Kanagawa Univ.) Lattices in crystalline representations and iterated extensions · · · · · · · · 10

Summary: Cais and Liu extended the theory of Kisin modules and crystalline representations to allow more general coefficient fields and lifts of Frobenius. Based on their theory, we classify lattices in crystalline representations by Kisin modules with additional structures under a Cais–Liu's setting. Furthermore, we give a geometric interpretation of Kisin modules of height one in terms of Dieudonné crystals of p-divisible groups.

14 Yuri Yatagawa (Univ. of Tokyo) Wild ramification of constructible sheaves and the direct images · · · · · 15

Summary: We introduce the notion that two elements of Grothendieck groups of constructible sheaves on a separated scheme over complete discrete valuation ring of finite type have the same wild ramification. We prove that having the same wild ramification is preserved by the direct image.

15 Yasuhiro Terakado (Univ. of Tokyo) The determinant and the discriminant of a complete intersection of even dimension · 15

Summary: The determinant of the Galois action on the etale cohomology of the middle degree of a proper smooth variety of even dimension defines a quadratic character of the absolute Galois group of the base field. We show that for a complete intersection of even dimension in a projective space, the character is computed via the square root of the discriminant of the defining polynomials of the variety.

16 Aiichi Yamasaki (Kyoto Univ.) Relation modules of dihedral groups · 15
Akinari Hoshi (Niigata Univ.)
Ming-chang Kang (Nat. Taiwan Univ.)

Summary: Let $D_n = \langle \sigma, \tau : \sigma^n = \tau^2 = 1, \tau\sigma\tau^{-1} = \sigma^{-1} \rangle$ be the dihedral group of order $2n$ where $n \geq 2$. Let k be any field. If $n = 2$, $k(R^{ab})^{D_2}$ is rational over k, i.e. purely transcendental over k. If n is an odd integer ≥ 3, then $k(R^{ab})^{D_n} = k(D_n)(t)$; thus, if Noether's problem for D_n over k has an affirmative answer (e.g. $\zeta_n + \zeta_n^{-1} \in k$), then $k(R^{ab})^{D_n}$ is rational over k. Let K/k be a Galois extension with $\mathrm{Gal}(K/k) = D_n$. If n is an even integer ≥ 2, then $K(R^{ab})^{D_n}$ is not stably rational over k. If n is an odd integer ≥ 3, then $K(R^{ab})^{D_n}$ is rational over k.

17 Akinari Hoshi (Niigata Univ.) Degree three unramified cohomology groups (II) 15
Ming-chang Kang (Nat. Taiwan Univ.)
Aiichi Yamasaki (Kyoto Univ.)

Summary: Let k be any field, G be a finite group. Let G act on the rational function field $k(x_g : g \in G)$ by k-automorphisms defined by $h \cdot x_g = x_{hg}$ for any $g, h \in G$. Denote by $k(G) = k(x_g : g \in G)^G$, the fixed subfield. Noether's problem asks whether $k(G)$ is rational (= purely transcendental) over k. The unramified Brauer group $\mathrm{Br}_{\mathrm{nr}}(\mathbb{C}(G))$ and the unramified cohomology $H^3_{\mathrm{nr}}(\mathbb{C}(G), \mathbb{Q}/\mathbb{Z})$ are obstructions to the rationality of $\mathbb{C}(G)$. Peyre proves that, if p is an odd prime number, then there is a group G such that $|G| = p^{12}$, $\mathrm{Br}_{\mathrm{nr}}(\mathbb{C}(G)) = 0$, but $H^3_{\mathrm{nr}}(\mathbb{C}(G), \mathbb{Q}/\mathbb{Z}) \neq 0$; thus $\mathbb{C}(G)$ is not stably $\mathbb{C}$-rational. Using Peyre's method, we are able to find groups G with $|G| = p^9$ where p is an odd prime number such that $\mathrm{Br}_{\mathrm{nr}}(\mathbb{C}(G)) = 0$, $H^3_{\mathrm{nr}}(\mathbb{C}(G), \mathbb{Q}/\mathbb{Z}) \neq 0$. This gives an explicit counter-example to integral Hodge conjecture with the aid of Colliot-Thélène and Voisin's theorem (2012).

18 Akinari Hoshi (Niigata Univ.) Multiplicative invariant fields of dimension ≤ 6 15
Ming-chang Kang (Nat. Taiwan Univ.)
Aiichi Yamasaki (Kyoto Univ.)

Summary: We are concerned with the rationality problem of the fixed field $\mathbb{C}(M)^G$. It is known that, if the unramified Brauer group, denoted by $\mathrm{Br}_{\mathrm{nr}}(\mathbb{C}(M)^G)$, is non-trivial, then the fixed field $\mathbb{C}(M)^G$ is not rational (= purely transcendental) over $\mathbb{C}$. Theorem 1. Among the 710 finite groups G, let M be the associated faithful G-lattice with $\mathrm{rank}_{\mathbb{Z}} M = 4$, there exist precisely 5 lattices M with $\mathrm{Br}_{\mathrm{nr}}(\mathbb{C}(M)^G) \neq 0$. In these situations, $B_0(G) = 0$ and thus $\mathrm{Br}_{\mathrm{nr}}(\mathbb{C}(M)^G) \subset H^2(G, M)$. The GAP IDs of the five groups G are (4,12,4,12), (4,32,1,2), (4,32,3,2), (4,33,3,1), (4,33,6,1). Theorem 2. There exist 6079 finite subgroups G in $GL_5(\mathbb{Z})$. Let M be the lattice with rank 5 associated to each group G. Among these lattices precisely 46 of them satisfy the condition $\mathrm{Br}_{\mathrm{nr}}(\mathbb{C}(M)^G) \neq 0$. The GAP IDs (actually the CARAT IDs) of the corresponding groups G may be determined explicitly. A similar result for lattices of rank 6 is found also.

March 25th (Sat) Conference Room II

9:00–12:00

19 Takahiro Hasebe (Hokkaido Univ.) Classifying posets by order quasisymmetric functions 15
Shuhei Tsujie (Hokkaido Univ.)

Summary: Richard P. Stanley conjectured that finite trees can be distinguished by their chromatic symmetric functions. We prove an analogous statement for posets: Finite rooted trees can be distinguished by their order quasisymmetric functions.

Summary: For any pair (ζ, ξ) of Newton polygons with $\zeta \prec \xi$, we construct a concrete specialization from the minimal p-divisible group of ξ to the minimal p-divisible group of ζ by a beautiful induction. This in particular gives the affirmative answer to the unpolarized analogue of the latter part of F. Oort, "Foliations in moduli spaces of abelian varieties". J. A. M. S. **17** (2004), no.2, 267–296. and gives another proof of the dimension formula of the central leaves in the unpolarized case.

Summary: The McLaughlin group McL is given as a subgroup of index 2 of the automorphism group of a certain graph with 275 vertices and is a sporadic simple group of order $2^7.3^6.5^3.7.11$. We explicitly write down an automorphism of order 2 of this graph which is not included in McL.

Summary: In this talk, we show that the intersection of the center and the nth right socle $ZS^n(A) := Z(A) \cap \mathrm{Soc}^n(A)$ of a finite dimensional algebra A is a Morita invariant; This is a generalization of important Morita invariants, the center $Z(A)$ and the Reynolds ideal $ZS^1(A)$. As an example, we also studied $ZS^n(FP)$ for a group algebra FP of a finite p-group P over a field F of positive characteristic p. Such an algebra have a basis along the radical filtration, known as the Jennings basis. We give sufficient conditions that an element of the Jennings basis is central and a lower bound for the dimension of $ZS^n(FP)$ for relatively small n. Equalities hold for $0 \leq n \leq p$ if P is powerful.

Summary: A multiplicative partition function for symmetric plane partitions with bounded parts is conjectured, which generalizes both the size generating function and the trace generating function for square-shaped symmetric plane partitions. The partition function has an expression in Pfaffians which should be helpful to prove the conjecture.

Summary: We give an algebraic proof for the generating function formula of generalized Hall–Littlewood functions. We also consider some applications for the generating function.

25 Tomonori Hashikawa (Tohoku Univ.) On conformal designs of minimal conformal weight spaces of SVOAs 10

Summary: The notion of conformal designs based on vertex operator algebras was introduced by G. Höhn, and is an analogue of those of combinatorial and spherical designs based on binary codes and integral lattices, respectively. In this talk, I give equivalent conditions to define conformal designs on the minimal conformal weight spaces of vertex operator superalgebras (SVOA for short). We see from this result that an exceptional SVOA with minimal conformal weight μ introduced by Tuite and Van is an SVOA whose minimal conformal weight space forms a conformal $2\lfloor \mu + 1 \rfloor$-design. Also, I introduce my recent result related to conformal designs.

26 Toshiyuki Abe (Ehime Univ.)
Ching Hung Lam (Academia Sinica)
Hiromichi Yamada (Hitotsubashi Univ.)
On a construction of vertex operator algebras having group-like fusion 10

Summary: A VOA is called to have group-like fusion if every irreducible module is a simple current. In this talk, I would like to give a construction of vertex operator algebras having group-like fusion.

27 Kazuya Kawasetsu (Academia Sinica)
Yuichi Sakai
Modular linear differential equations of fourth order and minimal $\mathcal{W}$-algebras 10

Summary: In this talk, we study a family of modular linear differential equations (MLDEs) of order 4 and vertex operator algebras by using the MLDEs. Recently, there are attempts to classify partially vertex operator algebras (VOAs) and characters of modules over VOAs in terms of the theory of MLDEs. We give the basis of solutions of the MLDE in the family which has a solution of vacuum type. Moreover, we give a characterization of minimal $\mathcal{W}$-algebras associated with the so-called Deligne exceptional series by using the family of MLDEs. We also study MLDEs of order 2, called Kaneko–Zagier equations,to study the family.

28 Tomoyuki Arakawa (Kyoto Univ.)
Kazuya Kawasetsu (Academia Sinica)
Quasi-lisse vertex algebras and modular linear differential equations 10

Summary: In this talk, we introduce a notion of quasi-lisse vertex algebras, which generalizes admissible affine vertex algebras. We show that the normalized character of an ordinary module over a quasi-lisse vertex operator algebra has a modular invariance property, in the sense that it satisfies a modular linear differential equation. As an application we obtain the explicit character formulas of simple affine vertex algebras associated with the Deligne exceptional series at level $-h^\vee/6 - 1$, which express the homogeneous Schur indices of 4d SCFTs studied by Beem, Lemos, Liendo, Peelaers, Rastelli and van Rees, as quasi-modular forms.

29 Tomoyuki Arakawa (Kyoto Univ.)
Thomas Creutzig (Univ. of Alberta)
Kazuya Kawasetsu (Academia Sinica)
Andrew R. Linshaw (Univ. of Denver)
Orbifolds and cosets of minimal $\mathcal{W}$-algebras 10

Summary: In this talk, we study the coset of affine vertex operator algebras (VOAs) inside minimal $\mathcal{W}$-algebras. We give a conjectural correspondence between the coset and principal $\mathcal{W}$-algebras of type C_n. We prove the conjecture for several cases by determining the strong generators of the cosets.

30 Kazuya Kawasetsu (Academia Sinica)
Ching Hung Lam (Academia Sinica)
Xingjun Lin (Univ. of Tsukuba)
$\mathbb{Z}_2$-orbifold construction associated with (-1)-isometry and uniqueness of holomorphic vertex operator algebras of central charge 24 10

Summary: In this talk, the vertex operator algebra structure of a strongly regular holomorphic vertex operator algebra V of central charge 24 is proved to be uniquely determined by the Lie algebra structure of its weight one space V_1 if V_1 is a Lie algebra of the type (A) $B_{n,2}^{12/n}$, $(n = 1, 2, 3, 4, 6, 12)$, (B) $D_{2n,2}^{4/n} B_{n,1}^{8/n}$, $(n = 1, 2, 4)$, (C) $D_{2n+1,2}^{4/n} A_{2n-1,1}^{4/n}$, $(n = 1, 2, 4)$, (D) $C_{4,1}^4$, or (E) $D_{6,2} B_{3,1}^2 C_{4,1}$. These Lie algebras are exactly the weight one Lie algebras of the holomorphic vertex operator algebras which are not isomorphic to lattice vertex operator algebras and are obtained by applying $\mathbb{Z}_2$-orbifold construction to the lattice vertex operator algebras associated to the Niemeier lattices with roots and lifts of the (-1)-isometry of the lattices.

31 Naoki Genra (Kyoto Univ.) Wakimoto representations for W-algebras 15

Summary: Let $\mathfrak{g}$ be a complex finite-dimensional simple Lie algebra, k a complex number, $V^k(\mathfrak{g})$ the affine vertex algebra associated with $\mathfrak{g}$ of level k. The Wakimoto representation of $V^k(\mathfrak{g})$ is constructed as the intersection of kernels of the screening operators if k is generic. Let f be a nilpotent element of $\mathfrak{g}$, $\mathcal{W}^k(\mathfrak{g}, f)$ the W-algebra associated with $\mathfrak{g}, f, k$. We construct the Wakimoto representations for the W-algebras by using those for $V^k(\mathfrak{g})$ and give the explicit formulas for the screening operators of the W-algebras.

13:30–14:30 Talk Invited by Algebra Section

Scott Carnahan (Univ. of Tsukuba) Recent advances in Moonshine

Summary: Monstrous Moonshine started in the 1970s, when numerical experimentation by McKay, Thompson, Conway, and Norton revealed relationships between the representation theory of the Monster simple group and a special class of modular functions known as Hauptmoduln, or principal moduli of genus zero groups. We now have a good understanding of both the original Monstrous Moonshine question and a later, more general set of phenomena found by Norton. They are completely controlled by a vertex operator algebra whose automorphism group is the Monster, and properties like modular invariance were understood by physicists since the 1980s as consequences of a conformal field theoretic interpretation.

In the last decade, several new Moonshine-like phenomena have been discovered, starting with the K3-Mathieu Moonshine observation of Eguchi–Ooguri–Tachikawa and most recently with skew-holomorphic moonshine, where computations are still in progress. These new Moonshines involve mock modular forms and Jacobi forms, which are more exotic than the modular functions that appear in the Monstrous case. For these new moonshines, we do not understand the underlying representation-theoretic objects, even on a physical level of rigor. However, all of them have been found to share a genus zero modularity property.

We now have a good set of mathematical tools for working with the genus zero property, but it is still conceptually mysterious, even for the Monstrous case. From a physical standpoint, working with the genus zero condition seems to require leaving the safe realm of conformal field theory to consider quantum gravity and strings.

March 26th (Sun) Conference Room II

9:15–12:00

Summary: Associated Legendre functions of the first kind give a family of BCOV rings on elliptic curves. The family represents some meromorphic ambiguity of the BCOV theory. We prove that the family is parametrized by q-exponents of the Dedekind eta function $\eta(q^{24})$. Our method involves a classification of rational solutions of a Riccati equation under some constraints.

Summary: A curve is called *superspecial* if its Jacobian is isomorphic to a product of supersingular elliptic curves. We prove that there is no superspecial curve of genus 4 in characteristic 7 (an answer to the genus 4 case of the problem by Ekedahl 1987). This implies the non-existence of maximal curve of genus 4 over $\mathbb{F}_{49}$, which updated the table at `manypoints.org`. We give an algorithm to enumerate superspecial nonhyperelliptic curves of genus 4 in arbitrary $p \geq 5$, and for $p \leq 7$ we execute it with our implementation on a computer algebra system Magma.

Summary: A fibered surface or a fibration is a surjective morphism from a smooth projective surface to a smooth complete curve with connected fibers. The slope of a fibered surface is defined by the ratio of the self-intersection number of the relative canonical bundle and the degree of the direct image sheaf of it. We give an upper bound of the slope for finite cyclic covering fibrations of a ruled surface and of an elliptic surface, such classes of which contains hyperelliptic fibrations, special trigonal fibrations and bielliptic fibrations.

Summary: We construct explicit examples of genus two fibrations with no sections on rational surfaces by the double covering method. For the proof of non-existence of sections, we use the theory of the virtual Mordell–Weil groups.

Summary: We say that a rank 2 bundle splits if it is given by an extension of two line bundles. In this talk, we will characterize the splitting types of Lazarsfeld–Mukai bundles of rank 2 on K3 surfaces, by ACM line bundles, and give an example of a non-split Lazarsfeld–Mukai bundle of rank 2.

37 Tomohiro Iwami (Kyushu Inst. of Tech.) ♭ Quasi-thin property for the Cremona group of rank 3 and its application to a rationality of 3-folds with a pencil of rational curves ····· 15

Summary: For the Cremona group $\mathrm{Cr}_n(k)$ of rank n over a field k, p-elementary subgroups of $\mathrm{Cr}_2(k)$ (Beauville), and finite simple subroups of $\mathrm{Cr}_3(\mathbb{C})$(Prokhorov), was classified. On the other hand, in the classification of finite simple groups, starting from characterization of finite simple groups by their Sylow 2-subgroups, finite simple groups of (non-)component type, as quasi-thin (Aschbacher–Smith), were studied. In this talk, the author will discuss a structure of 3-folds with a pencil of rational curves, which has the automorphism group of its 2-dimensional fiber is isomorphic to a p-elementary subgroup of $\mathrm{Cr}_2(k)$, as in the case of (non-)component types for finite simple subgroups of $Cr_3(k)$, with regards to rationality of such 3-folds.

38 Tetsuya Ando (Chiba Univ.) Semialgebraic varieties and symmetric inequalities of degree four with four variables ····· 15

Summary: We introduce a notion of semialgebraic varieties to study algebraic inequalities. Then, regular maps, rational maps, critical sets, and so on can be defined. Using the above, we determine discrimimants of some PSD cones of symmetrics homogeneous polynomials with four variables of degree four.

39 Takeshi Torii (Okayama Univ.)
Kazunori Nakamoto (Univ. of Yamanashi)
On the moduli of subalgebras of the full matrix ring of degree 3 (Part I) ····· 15

Summary: We show that the moduli of 2-dimensional subalgebras of the full matrix ring of degree 3 is isomorphic to $\mathbb{P}^2_{\mathbb{Z}} \times \mathbb{P}^2_{\mathbb{Z}}$.

40 Yoshifumi Tsuchimoto (Kochi Univ.) Non commutative complex projective varieties ····· 15

Summary: We define non commutative complex projective varieties. De Rham cohomology groups are computed and relation with the original commutative varieties are discussed.

41 Yusuke Suyama (Osaka City Univ.) Toric Fano varieties associated to finite simple graphs ····· 10

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

14:30–15:30 Award Lecture for the 2017 MSJ Algebra Prize

Masanobu Kaneko (Kyushu Univ.) On multiple zeta values

Summary: Multiple zeta values are real numbers defined by a simple series. They were originally studied by Goldbach and Euler, and have been much studied in recent years in connection with many branches in mathematics and mathematical physics.
I shall give an overview of the theory of multiple zeta values, with emphasis placed on topics which I have been involved with since these two decades. I shall also present some of my recent work on multiple zeta values.

15:40–16:40 Award Lecture for the 2017 MSJ Algebra Prize

Mitsuyasu Hashimoto (Okayama Univ.) Commutative algebra and invariant theory

Summary: The purpose of this talk is to overview studies by the speaker in commutative algebra and invariant theory.

The first topic is the problem of minimal free resolutions of determinantal ideals and their relatives. This is partly joint with K. Kurano. Using the machineries of characteristic-free representation theroy of general linear groups developed by D. A. Buchsbaum and others, we studied lower syzygies of determinantal ideals. In particular, we showed that determinantal ideals do not have minimal free resolutions over the ring of integers in general.

The second topic is the strong F-regularity of invariant subrings. As a characteristic p version of Boutot's theorem, we prove the following. Let k be an algebraically closed field of characteristic $p > 0$, G a reductive group over k. Let V be a finite dimensional G-module. If $B = \operatorname{Sym} V$ has a good filtration as a G-module, then the invariant subring $A = B^G$ is strongly F-regular. Under the same assumption, B^U is a strongly F-regular UFD if U is the unipotent radical of any paraboloc subgroup of G.

The third topic is the construction of equivariant twisted inverse and the proof of the equivariant duality of proper morphisms. As an application, we generalized Watanabe's result on Gorensteinness of the ring of invariants under the action of finite groups to the action of finite group schemes.

In the talk, other works by the speakers will also be mentioned.

16:50–17:50 Award Lecture for the 2017 MSJ Algebra Prize

Toshiyuki Katsura (Hosei Univ.) Algebraic geometry in positive characterisitc

Summary: There are many peculier phenomena in the area of algebaraic geometry in positive characteristic which don't exist in characteristic 0. In 1950', such phenomea were shadowy and were called pathologies. Since then, many techniques and tools to examine them were developed and we can now understand them quite well. In this talk, I pick up some such problems in positive characteristic and explain the results to which I could contribute. The topics are as follows:

(1) Elliptic surfaces in positive characteristic,
(2) The moduli of principally polarized abelian varieties in characteristic p,
(3) The moduli of K3 surfaces in characteristic p,
(4) Unirational surfaces in characteristic p,
(5) The classification of Enriques surfaces in characteristic 2.

March 27th (Mon) Conference Room II

9:15–12:00

Summary: I report a trial on the regularization problem of Chern classes and character computations. It is from the OPEs and coordinate transforms for complex quasi-smooth quasi-projective varieties. This is a cousin of the 'chiral' conformal field theory—Malikov–Schechtman–Vaintrob and also Beilinson–Drinfeld to control vertex algebras by algebraic analysis. This conformal field theory is a special case of the physical quantum field theory, and the calculus is simplified by differential geometry or the twistor theory. However, the definition became ill-defined. I tried to clean such an awkward situation. The key is the incompatibility of the local and the global phenomena—the propagation of the local property doesn't work. I concentrated on low dimensional concrete examples of Fano varieties, Hirzebruch surfaces, and 3-dimensional space. I tried the plus-minus convergence of operators and $n!$ coefficient problem of some arithmetic.

Summary: Based on analysis of the residues of the resolvent, we have proposed an efficient algorithm for calculating eigenvector(s) of matrices. Our algorithm uses pseudo annihilating polynomials, and the elements in eigenvector are represented as a polynomial in eigenvalue as a variable, thus we do not need to find eigenvalues by solving the characteristic equation. We propose an improvement of efficiency of our algorithm in calculating a candidate of the eigenvector with parallelized Horner's rule for matrices.

Summary: For a given matrix with integers, we consider calculating its matrix inverse. From many algorithms for that task, we pick up one by putting the matrix into the variable in its characteristic or the minimal polynomial. Based on analysis of the residues of the resolvent, we have proposed efficient algorithms for matrices such as spectral decomposition and calculating (generalized) eigenspaces, etc. Among them, we have proposed an algorithm for calculating minimal annihilating polynomials and an extended Horner's rule for efficient evaluation of univariate polynomial with a matrix. With this result, we propose an algorithm for calculating matrix inverse by evaluating pseudo minimal polynomial via pseudo annihilating polynomial of the matrix using the extended Horner's rule, and show its effects by examples.

Summary: In this talk, we study toric ideals associated with multichains of posets. It is shown that the comparability graph of a poset is chordal if and only if there exists a quadratic Gröbner basis of the toric ideal of the poset. Strong perfect elimination orderings of strongly chordal graphs play an important role.

Summary: It is known that every integral convex polytope is unimodularly equivalent to a face of some Gorenstein Fano polytope. In this talk, we discuss whether every normal polytope is unimodularly equivalent to a face of some normal Gorenstein Fano polytope. In particular, we show that for order polytopes and chain polytopes, this question is true.

Summary: It is known that lattice simplices of dimension d corresponds finite abelian subgroups of $(\mathbb{R}/\mathbb{Z})^{d+1}$. In this talk, by using this correspondence we characterize Gorenstein simplices whose associated finite abelian subgroups are generated by one element. Furthermore, we characterize Gorenstein simplicies whose normalized volume equals p, p^2 and pq, where p and q are prime numbers with $p \neq q$.

Summary: Koszulness of Gorenstein quadratic algebras of small socle degree is studied. In this note, we construct non-Koszul Gorenstein quadratic toric ring such that its socle degree is more than 3 by using stable set polytopes.

Summary: Let $2 \leq m \leq n$ be integers, $X = [X_{ij}]$ be an $m \times n$ matrix of indeterminates over a field k. We denote by $S = k[X]$ the polynomial ring generated by $\{X_{ij}\}_{1 \leq i \leq m, 1 \leq j \leq n}$ over the field k. Let $\mathrm{I}_t(X)$ be the ideal of S generated by the $t \times t$ minors of the matrix X, where $2 \leq t \leq m$. We put $R = S/\mathrm{I}_t(X)$. In this situation R is a Cohen–Macaulay normal domain with $\dim R = mn - (m - (t-1))(n - (t-1))$. Moreover, the ring R is Gorenstein if and only if $m = n$. The aim of my talk is to study the question of when the determinantal rings are almost Gorenstein rings.

Summary: We study the Gorenstein property of a diagonal subalgebra of a $\mathbb{Z}^n$-graded ring. Then we give a sufficient condition for this algebra to be Gorenstein. As an application, we apply our result to multi-Rees algebras.

Summary: We study the Gorenstein Rees algebra of ideals in a commutative ring. We consider the Rees algebra $R(I)$ defined by a Huneke–Ulrich ideal. Then we determine the structure of I, completely.

14:15–16:00

Summary: We introduce ω-multiplier ideals. An ω-multiplier ideal is the ideal measuring the gap between the multiplier module and the canonical module. On the other hand, a core of ideal of I is the intersection of all reductions of I. In this talk, we show properties of cores of ideals and ω-multiplier ideals. As an application, we give a characterization for rational singularities.

Summary: Let K be an infinite field $n \geq 2$ be an integer and $T = (T_{ijk})$ a tensor of indeterminates of format $2 \times 2 \times n$. We define the action of $SL(2,K) \times SL(2,K)$ on the polynomial ring $K[T_{ijk} \mid 1 \leq i \leq 2, 1 \leq j \leq 2, 1 \leq k \leq n]$ by defining the action of $(P,Q) \in SL(2,K) \times SL(2,K)$ sending each element of $T_k = (T_{ijk})$ to the corresponding element of $P^T T_k Q$. We have shown that the initial subalgebra of the ring of invariants under this action is a certain Ehrhart ring if $n \leq 4$. It is open if this is true for any n. In this talk, we state the generators of the above mentioned Ehrhart ring and show that this Ehrhart ring is a standard graded algebra for any n.

Summary: We determine the ring structure of the Hochschild cohomology $HH^*(\Gamma)$ of an integral cyclic algebra Γ by giving a projective bimodule resolution of Γ and calculating cup product by means of a diagonal approximation map.

Summary: In this talk, we consider the following conjecture: for any 3-dimensional quadratic AS-regular algebra A, there exists a Calabi–Yau AS-regular algebra C such that A and C are graded Morita equivalent. We show that this conjecture holds in almost all cases.

Summary: The relative derived dimensions can realize the several invariants for rings, for instance, the global dimension. It, however, is difficult to give an explicit value of the relative derived dimension, in general. In this talk, I will give the explicit value when the subcategory is associated with a cotilting module.

Summary: Recently, 3-dimensional noetherian quadratic Calabi–Yau algebras were studied by Mori and Smith from the point of view of superpotentials. As a continuation, in this talk, we study 3-dimensional noetherian cubic Calabi–Yau algebras using superpotentials. We first give a classification of 3-dimensional noetherian cubic Calabi–Yau superpotentials. As applications of the classification, we show the results on the point schemes and the homological determinants for 3-dimensional noetherian cubic Calabi–Yau algebras.

Geometry

March 24th (Fri) Conference Room VIII

9:45–11:45

1 Tatsuya Yamashita (Hokkaido Univ.) Localizations of derivations in C^∞-schemes ····· 15

Summary: The main purpose of this presentation is to provide several results on objects lying between differential geometry and algebraic geometry such as C^∞-rings and derivations on a C^∞-ring. A C^∞-ring is defined as a ring with operations by C^∞-functions on Euclidean spaces. A C^∞-ringed space is a topological space with a sheaf and a C^∞-scheme is a locally spectrum of C^∞-rings. The main result of this presentation is to show that any derivation of global sections coincides a tangent vector field on a C^∞-scheme for some classes of C^∞-schemes.

2 Yuya Takeuchi (Univ. of Tokyo) Q-prime curvature and Sasakian η-Einstein manifolds ····· 15

Summary: The Q-prime curvature is defined for a pseudo-Einstein contact form on a strictly pseudoconvex CR manifold, and its integral, the total Q-prime curvature, defines a global CR invariant under some assumptions. In this talk, we will compute the Q-prime curvature for Sasakian η-Einstein manifolds. We will also study the first and second variation of total Q-prime curvature under deformations of real hypersurfaces at Sasakian η-Einstein manifolds.

3 Kotaro Kawai (Univ. of Tokyo) Second order deformations of associative submanifolds in nearly parallel G_2-manifolds ····· 15

Summary: Associative submanifolds A in nearly parallel G_2-manifolds Y are minimal 3-submanifolds in spin 7-manifolds with a real Killing spinor. The Riemannian cone over Y has the holonomy group contained in Spin(7) and the Riemannian cone over A is a Cayley submanifold.
We give a necessary and sufficient condition for an infinitesimal associative deformation to be integrable (unobstructed) to second order explicitly. As an application, we show that the infinitesimal deformations of a homogeneous associative submanifold in the 7-sphere given by Lotay, which he called A_3, are unobstructed to second order.

4 Hiroshi Sawai (Numazu Nat. Coll. of Tech.) Locally conformal Kähler structures on solvmanifolds ····· 15

Summary: Locally conformal Kähler manifold is said to be a Vaisman manifold if the Lee form is parallel with respect to Riemannian metric. The purpose in this talk is to prove that Inoue surface has no Vaisman structures.

5 Ryosuke Nomura (Univ. of Tokyo) The positivity of the canonical bundle of compact Kähler manifold with negative holomorphic sectional curvature ····· 15

Summary: Recently, Wu–Yau and Tosatti–Yang established the connection between the negativity of holomorphic sectional curvatures and the positivity of canonical bundles for compact Kähler manifolds. In this talk, we give another proof of their theorems by using the Kähler–Ricci flow.

Summary: The logarithmic Chow (semi)stability is defined for the pair consists of polarized complex manifolds and its divisors. In this talk, we will introduce a obstruction of semistability of polarized toric manifolds and its toric divisors. As its application, we will also introduce the followings. (1) A relation between the log Chow semistability and the log K-semistability which is expected to be equivalent to the existence of canonical Kähler metrics on polarized complex manifolds. (2) Calculation of this obstruction for a few example and relation to the existence of conical Kähler Einstein metrics.

Summary: The complete Ricci-flat manifolds with euclidean volume growth and smooth cross section always have the unique tangent cone at infinity by the result due to Colding and Minicozzi. In this talk I introduce the example of hyper-Kähler manifolds of dimension 4 whose volume growth is not euclidean and whose moduli space of tangent cones at infinity is homeomorphic to S^1.

14:15–16:10

Summary: In this talk, we first state known results for the regularized mean curvature flow starting from an invariant hypersurface in a Hilbert space equipped with an isometric and almost free action of a Hilbert Lie group whose orbits are regularized minimal. Next we prove that, if the invariant hypersurface satisfies a certain kind of horizontally convexity condition, then it collapses to an orbit of the Hilbert Lie group action along the regularized mean curvature flow.

Summary: Let M be a closed Kähler manifold of positive Ricci curvature and K a connected compact Lie group acting on M as holomorphic isometries. In this talk, we show the minimality of a K-invariant Lagrangian submanifold L in M w.r.t. a globally conformal Kähler metric is equivalent to the minimality of the reduced Lagrangian submanifold $L_0 = L/K$ in a Kähler quotient M_0 w.r.t. the Hsiang–Lawson metric. Furthermore, we give some examples of Käler reductions by a circle action obtained from a chomogenenity one action on M. Applying these results, we obtain many examples of minimal Lagrangian submanifolds via reductions.

Summary: In the 3-dimensional Lorentz–Minkowski space we prove that the sign of the Gaussian curvature of any timelike minimal surface is determined only by the orientations of the two null curves that generate the surface. Moreover, we also investigate the behavior of the Gaussian curvature of a timelike minimal surface with some kind of singularities.

11 Isami Koga (Kyushu Univ.)
Yasuyuki Nagatomo (Meiji Univ.)
Equivariant holomorphic embeddings from the complex projective line into a complex Grassmannian of 2-planes 15

Summary: We classify $SU(2)$ equivariant holomorphic embeddings from the complex projective line equipped with Fubini–Study metric into a complex Grassmannian manifold of 2-planes equipped with invariant Hermitian metric.

12 Shigeo Kawai (Saga Univ.*)
Nobumitsu Nakauchi (Yamaguchi Univ.)
On the stationary maps of a functional related to pullbacks of metrics 15

Summary: Properties of stationary maps for a functional related to pullbacks of metrics are investigated. One of the main results is outlined as follows: If the Ricci curvature of a minimal submanifold of the unit sphere is large enough, then stable stationary maps from or to it are constant maps.

13 Makoto Sakaki (Hirosaki Univ.)[♭]
Ruled surfaces with bi-null curves and marginally trapped surfaces ... 10

Summary: We discuss ruled surfaces with bi-null curves in the 5-dimensional semi-Euclidean space of index 2, and we get some classes of flat marginally trapped surfaces.

14 Yoshio Agaoka (Hiroshima Univ.)
Takahiro Hashinaga (Kitakyushu Nat. Coll. of Tech.)
A necessary and sufficient condition for a 3-dimensional Riemannian manifold to be locally a submanifold of the 4-dimensional Euclidean space 15

Summary: We give an intrinsic characterization of a three dimensional Riemannian manifold M^3 such that it can be locally isometrically immersed into the four dimensional Euclidean space $\mathbb{R}^4$, under a generic condition on the curvature of M^3. The results can be expressed by Thomas' inequality on curvature tensors and Rivertz' polynomial relations on curvature and its covariant derivative. By applying our results, we can easily check whether a given Riemannian manifold M^3 can be locall isometrically imbbeded into $\mathbb{R}^4$ or not for most M^3.

16:20–17:20 Talk Invited by Geometry Section

Atsufumi Honda (Miyakonojo Nat. Coll. of Tech.)
Geometry of positive semi-definite metrics and isometric realization problem

Summary: In this talk, we shall introduce two classes of positive semi-definite metrics on smooth 2-manifolds called Kossowski metrics and Whitney metrics. Kossowski and Whitney metrics are intrinsic formulations of wave fronts and smooth maps with cross cap singularities, respectively. After a brief introduction to Kossowski and Whitney metrics, we will prove the Gauss–Bonnet type formulas. We shall also discuss recent works on the isometric realization problem for such metrics. In particular, our results provide isometric deformations of cuspidal edges, swallowtails and cuspidal cross caps.

March 25th (Sat) Conference Room VIII

9:20–11:30

15 Dounnu Sasaki (Waseda Univ.) Extension of intersection number and subset currents on surfaces · · · · 15

Summary: We extend the (geometric) intersection number of closed curves on a compact hypebolic surface Σ to the intersection number of "surfaces" on Σ. We also see that the intersection number of "surfaces" on Σ can be extended to a unique continuous $\mathbb{R}_{\geq 0}$-bilinear functional on the space of subset currents on Σ, which can be thought of as the completion of the set of "surfaces" on Σ with positive real weight.

16 Motoko Kato (Univ. of Tokyo) Embeddings of right-angled Artin groups into higher-dimensional Thompson groups · 10

Summary: Thompson group V is a subgroup of the homeomorphism group of the Cantor set C. Bleak and Salazar-Díaz showed that $\mathbb{Z}^2 * \mathbb{Z}$ does not embed in V. Brin defined higher dimensional Thompson groups as generalizations of V. n-dimensional Thompson group nV is a subgroup of the homeomorphism group of C^n. We constructed embeddings of right-angled Artin groups into higher dimensional Thompson groups. Especially, we may embed $\mathbb{Z}^2 * \mathbb{Z}$ in $2V$.

17 Johannes Jaerisch (Shimane Univ.) Growth and cogrowth of normal subgroups of a free group · · · · · · · · · · 15
Katsuhiko Matsuzaki (Waseda Univ.)

Summary: We give a sufficient condition for a sequence of normal subgroups of a free group to have the property that both, their growths tend to the upper bound and their cogrowths tend to the lower bound. The condition is represented by the planarity of the quotient graphs of the tree. We make use of an analogue of Cheeger's inequality in Riemannian geometry to estimate the bottom of the spectrum of the discrete Laplacian.

18 Kazuyoshi Watanabe (Tohoku Univ.) Combinatorial differential form and Gauss–Bonnnet theorem · · · · · · · · 10

Summary: R. Forman defined a combinatorial differential form on a cell-complex. We show that Hodge Laplacian is defined on the combinatorial differential form and Ricci curvature for combinatorial differential one form is constructed on the cell-complex by using the Weitzenbeck–Bochner formula. The Ricci curvature is derived from a combinatorial calculation. For 1 or 2-dimension complex, we show the combinatorial Gauss–Bonnet theorem, i.e. the summation of the Ricci curvature for a combinatorial differential one form is the constant multiplication of the Euler number for the cell-complex.

19 Taiki Yamada (Tohoku Univ.) Curvature dimension inequality on directed graphs · · · · · · · · · · · · · · · · · 10

Summary: Curvature dimension inequalities which are defined from Bochner formula encode analytic properties of Ricci curvature. I have defined Ricci curvature on directed graphs. Thus, the purpose of this lecture is that we define curvature dimension inequalities on directed graphs, and prove some analytic properties. To define them, we modify the definition of the laplacian by Chung and the definition of the Γ-calculation by Jost, and expand them on directed graphs.

20 Homare Tadano (Osaka Univ.) Cheeger–Gromov–Taylor type compactness theorems via Bakry–Émery and modified Ricci curvatures 15

Summary: We will establish some Cheeger–Gromov–Taylor type compactness theorems for complete Riemannian manifolds via Bakry–Émery and modified Ricci curvatures. Our compactness theorems improve previous ones obtained by Fernández-López and García-Río (2008), Limoncu (2010, 2012), Qian (1997), Wei and Wylie (2009), and Wylie (2015).

21 Mitsuhito Itoh (Univ. of Tsukuba) Hessian of Busemann function and rank of geodesics on Hadamard manifolds 10
Hiroyasu Satoh (Nippon Inst. of Tech.)

Summary: In this talk we would like to report our recent geometrical result of relationship between Hessian of Busemann function and geodesic rank on an analytic Hadamard manifold. The Riccati differential equation along a geodesic in terms of shape operator of horospheres is a key for our study.

22 Tetsuya Nagano (Univ. of Nagasaki) Branching of geodesic at one point in Finsler space 15

Summary: A geodesic in Finsler space exists unique at any point and any direction locally. This fact is the same as in Riemannian case. However, through one point of x, an going geodesic along a direction y is different from the going geodesic along $-y$. The speaker found a close relation between the notion of linear parallel displacement and reversible geodesic. According to the study, we notice geodesics have at least three types at one point.

23 Nobuhiro Innami (Niigata Univ.) On the nearest cut point 15

Summary: We prove the Finsler version of Klingenberg's lemma concerning the nearest cut point.

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

Yu Kitabeppu (Kumamoto Univ.)[♭] On regular sets in metric measure spaces

Summary: We are able to define the concept of metric measure spaces with Ricci curvature bounded from below, by using optimal transportation techniques. The family of such spaces, called RCD spaces, are one of the orthodox generalization of Riemannian manifolds with bounded Ricci curvature and moreover contains the Ricci limit spaces. Hence RCD spaces must have very wild local structures in general. However it is known that the tangent cone at almost every points is the standard Euclidean space.
In this talk, we give two conditions. One is the existence of 1-dimensional regular set, another is a Bishop-type inequality. We show that the local structures of RCD spaces with one of such conditions become milder.

March 26th (Sun) Conference Room VIII

9:50–11:40

24 Qing Song Shi (Nagoya Inst. of Tech.) Toshiaki Adachi (Nagoya Inst. of Tech.) Comparison theorems on trajectory-harps II · · · · · 10

Summary: A trajectory-harp is a variation of geodesics associated with a trajectory for a Kähler magnetic field, which is a constant multiple of the Kähler form of a Kähler manifold M. Last fall we study "lengths" of trajectory-harps. This time we study their widths by investigating their zenith angles which are lengths of curves in the tangent bundle formed by initial vectors of geodesics. We compare trajectory-harps with those in a complex space form under the assumption that sectional curvatures of the underlying manifold are bounded from above or from below.

25 Qing Song Shi (Nagoya Inst. of Tech.) Toshiaki Adachi (Nagoya Inst. of Tech.) Asymptotic behavior of trajectories on Hadamard Kähler manifolds · · 10

Summary: Let M be a Hadamard Kähler manifold, that is, a simply connected Kähler manifold whose sectional curvatures satisfy $\mathrm{Riem}^M \leq c < 0$. By using a comparison theorem on trajectory-harps, we show that every trajectory for a Kähler magnetic field $\mathbb{B}_\kappa$ has limit points in the ideal boundary of M if $|\kappa| \leq \sqrt{|c|}$. Also, we study variations of trajectories associated with geodesics, and investigate we can two distinct points by a trajectory if $|\kappa| < \sqrt{|c|}$.

26 Tomoya Nakamura (Waseda Univ.) Pseudo-Poisson Nijenhuis manifolds · · · · · 15

Summary: We introduce the notion of pseudo-Poisson Nijenhuis manifolds which is analogous to Poisson quasi-Nijenhuis manifolds of Stiénon and Xu. Both these manifolds are generalizations of Poisson Nijenhuis manifolds of Magri and Morosi. Similar to the case of Poisson quasi-Nijenhuis manifolds, we show that any pseudo-Poisson Nijenhuis manifold has an associated quasi-Lie bialgebroid. Hence an associated Courant algebroid is obtained. We provide some examples of pseudo-Poisson Nijenhuis manifolds.

27 Noriaki Ikeda (Ritsumeikan Univ.) Marc Heller (Tohoku Univ.) Satoshi Watamura (Tohoku Univ.) A Courant algebroid on a Poisson manifold and applications to T-duality · · · · · 15

Summary: A Courant algebroid is a 2-categorical object corresponding to a Lie algebroid. We consider a Courant algebroid on a Poisson manifold and generalized duality between the de Rham cohomology and the Poisson cohomology. Moreover, we unify geometry of nongeometric fluxes using supergeomtric formulation of the double field theory to describe T-duality in string theory.

28 Akifumi Sako (Tokyo Univ. of Sci.) Formulation and exact solution of matricial Φ_2^3 quantum field theory · · · · · 15

Summary: We formulate the Φ^3 quantum field theory as the Φ^3 matrix model, also known as regularised Kontsevich model and exactly solve it. Its correlation functions collectively describe graphs on a multi-punctured 2-sphere. We show how Ward–Takahashi identities and Schwinger–Dyson equations lead in a special large-$\mathcal{N}$ limit to integral equations that we solve exactly for all correlation functions.
The solved model arises from noncommutative field theory on the Moyal plane in a special limit of strong deformation parameter.

29 Shigehiro Sakata (Univ. of Miyazaki) Characterization of symmetry of a convex body with radial centers 15

Summary: We investigate stationary radial centers of a body. The existence is equivalent to that of stationary hot spots. From Magnanini and Sakaguchi's result, the existence of stationary hot spot of a convex body is equivalent to the balance law. Using the balance law, we characterize a planar convex polyhedron having stationary radial centers.

30 Jun O'Hara (Chiba Univ.) Characterization of unit balls by regularized Riesz energy 15

Summary: We show that the unit balls can be characterized by the residues of Riesz energy that is regularized by analytic continuation.

14:15–15:35

31 Yoshinori Tanimura (Univ. of Tokyo) On the flexibility of Clifford–Klein forms whose translation groups are solvable Lie groups whose Lie algebras are graded 15

Summary: We discuss the flexibility of Clifford–Klein forms whose translation groups are solvable Lie groups whose Lie algebras are graded. In 2016, Iméd Kedim showed the flexibility in the case that translation group is the diamond group. We will generalize this result to the case that translation groups are some 1-connected Lie groups whose Lie algebras are solvable, graded and satisfying a certain condition. More precisely, we define the Lie subalgebra $\mathfrak{g}'$ of the graded Lie algebra $\mathfrak{g}$ satisfying that condition and the argument about the local rigidity of the elements of $\mathcal{R}(\Gamma, G, H)$ essentially results the argument about $\mathcal{R}(\Gamma, G')$.

32 Daisuke Tarama (Ritsumeikan Univ.) Wolfram Bauer (Univ. Hannover) Integrability of geodesic flow on step-two nilpotent Lie groups of H-type with respect to a left-invariant metric 10

Summary: This talk deals with the complete integrability of the geodesic flow on step-two nilpotent Lie groups of H-type with respect to a left-invariant Riemannian metric. A set of the maximal number of independent and Poisson commuting first integrals is explicitly constructed to show the integrability.

33 Kaoru Ikeda (Keio Univ.)[b] Gauss decompositions of the semisimple Lie groups and the fundamental groups of the flag variety 15

Summary: We consider the Gauss decompositions of the semisimple Lie groups. To show the exisistence w, the element of the Weyl group such that wg has Gauss decomposition for any $g \in G$ we have to consider the fundamental group of the flag manifold G/B, where B is the Borel subgroup of G.

34 Hiroyuki Tasaki (Univ. of Tsukuba) Sequences of maximal antipodal sets in oriented real Grassmann manifolds 15

Summary: Let $([n], k)$ be the set consisting of all subsets of cardinalities k in $[n] = \{1, \ldots, n\}$. A subset A of $([n], k)$ is *antipodal*, if for any α and β in A the cardinality of $\alpha - \beta = \{i \in \alpha \mid i \notin \beta\}$ is even. An antipodal set of $([n], k)$ is related to an antipodal set of the oriented real Grassmann manifold $\tilde{G}_k(\mathbf{R}^n)$, which was introduced by Chen–Nagano. We have already obtained the classification of maximal antipodal sets of $([n], k)$ for $k \leq 4$ and some sequences of maximal antipodal sets of $([n], k)$. In this talk we construct new sequences of maximal antipodal sets of $([n], k)$, which are generalizations of those obtained in previous results.

Summary: In 1979, D' Atri and Ziller obtained a large number of invariant Einstein metrics on compact semi-simple Lie groups. They gave a characterization of naturally reductive metrics on compact simple Lie groups. They also asked whether non-naturally reductive Einstein metrics on compact semi-simple Lie groups exist or not. We give a short summary on known results of non-naturally reductive Einstein metrics on compact simple Lie groups and discuss on new non-naturally reductive Einstein metrics on SU(n) (n>4).

15:50–16:50 Talk Invited by Geometry Section

Takayuki Okuda (Hiroshima Univ.)♭ Pairs of totally geodesic submanifolds in Riemannian symmetric spaces without common geodesics

Summary: Let M be a connected Riemannian symmetric space of non-compact type and denote by G the isometry group of M. For each totally geodesic (complete) submanifold L of M, the subgroup $H := \{g \in G \mid gL = L\}$ is reductive in G. Then $[L] \simeq G/H$ is a homogeneous space of reductive type, where $[L]$ is the G-conjugacy class of L in M. We remark that such $[L] \simeq G/H$ admits G-invariant pseudo-Riemannian matrics.

For a pair of totally geodesic submanifolds (L_1, L_2) of M, we obtain a pair of reductive subgroups (H_1, H_2) of G. In this setting, as a corollary to the properness criterion by T. Kobayashi [Math. Ann. (1989)], we see that the following four conditions on (M, L_1, L_2) are equivalent: **(i)** $[L_1]$ and $[L_2]$ have no common geodesics in M, where we say that a geodesic l in M is common to $[L_1]$ and $[L_2]$ if there exists $g_1, g_2 \in G$ such that $l \subset g_1L_1 \cap g_2L_2$. **(ii)** The H_1-action on $[L_2] \simeq G/H_2$ is proper. **(iii)** The H_2-action on $[L_1] \simeq G/H_1$ is proper. **(iv)** The diagonal G-action on $[L_1] \times [L_2]$ is proper. In this talk, we show some classification results of (M, L_1, L_2) satisfying the equality conditions above.

Complex Analysis

March 24th (Fri) Conference Room VII

9:30–11:50

1 Saburou Saitoh ♭ The general sampling theory by using reproducing kernels ····· 15
(Gunma Univ.*/Inst. of Reproducing Kernels)
Hiroshi Fujiwara (Kyoto Univ.)

Summary: We would like to propose a new method for the sampling theory which represents the functions by a finite number of point data in a very general reproducing kernel Hilbert space function space. The result may be looked as an ultimate sampling theorem in a reasonable sense. We shall give numerical experiments also as its evidences.

2 Saburou Saitoh ♭ $\log 0 = \log \infty = 0$ and applications ····· 15
(Gunma Univ.*/Inst. of Reproducing Kernels)
Hiroshi Michiwaki (NejiLaw Inc.)

Summary: In this talk, we will show that $\log 0 = \log \infty = 0$ by the division by zero $z/0 = 0$ and its fundamental applications. In particular, we will know that the division by zero is our elementary and fundamental mathematics.

3 Shigeyoshi Owa (Yamato Univ.) Analytic functions concerning with some subordinations ····· 15
Junichi Nishiwaki (Setsunan Univ.)

Summary: For analytic functions in the class $\mathcal{A}_n$ in the open unit disk $\mathbb{U}$, two subclasses $\mathcal{S}_n^*(\alpha)$ and $\mathcal{K}_n(\alpha)$ of starlike functions and convex functions are introduced. The object of the present talk is to discuss some interesting properties of functions in the classes $\mathcal{S}_n^*(\alpha)$ and $\mathcal{K}_n(\alpha)$ with some subordinations.

4 Hirokazu Shimauchi Numerical solution of the radial Loewner equation ····· 15
(Yamanashi Eiwa Coll.)
Ikkei Hotta (Yamaguchi Univ.)

Summary: The Loewner equation provides a one-parametric family of conformal maps on the unit disk whose images describe a flow of an expanding simply-connected domain on the complex plane. In this talk we present a numerical algorithm for solving the radial Loewner equation. Our algorithm is based on a recursive formula for determining coefficients of polynomial approximations. We show that each coefficient converges to true values with reasonable regularity.

5 Yoshikazu Yamagishi (Ryukoku Univ.) Disk packings on logarithmic spiral lattices ····· 10
Takamichi Sushida (Hokkaido Univ.)

Summary: A logarithmic spiral lattice is a multiplicative group $\Lambda(z)$ generated by a complex number z. We consider the disk packing and Voronoi tiling on $\Lambda(z)$. It is proved that the bifurcation diagram of disk packings is connected and simply connected, as it is a dual graph to the bifurcation diagram of Voronoi tilings. The Farey tree structure and the bounded distance function $d(z, w) = |z - w|/(|z| + |w|)$ play important roles.

6 Masashi Kisaka (Kyoto Univ.)
Tomoki Kawahira (Tokyo Tech)
Abundance of semihyperbolic dynamics in the boundary of the Mandelbrot set 15

Summary: We show that the Hausdorff dimension of the set of all semihyperbolic parameter in the boundary of the Mandelbrot set M is equal to 2. This means that comparably understandable dynamics is abundant in the boundary of M.

7 Takanori Matsuno
(Osaka Pref. Univ. Coll. of Tech.)
An application of strongly branched coverings 10

Summary: R. D. M. Accola developed a theory of strongly branchecd coverings of compact Riemann surfaces. In this talk, applying the theory of strongly branched coverings, for any given finite simple group, we construct a Riemann surface whose automorphism group is the finite simple group.

8 Takanori Matsuno
(Osaka Pref. Univ. Coll. of Tech.)
A remark on Hurwitz groups 10

Summary: By a theorem of Hurwitz, a compact Riemann surface of genus $g \geq 2$ cannot have more than $84(g-1)$ automorphisms. It is known that the bound is attained for infinitely many values of g. In this talk, we show that the bound is often not sharp.

9 Hiroshige Shiga (Tokyo Tech)
On holomorphic motions and the extension problem 15

Summary: Let E be a subset of the Riemann sphere and ϕ be a holomorphic motion of E over a Riemann surface X. In this talk, we consider a condition of ϕ under which ϕ is extended to a holomorphic motion of the Riemann sphere over X.

14:15–16:05

10 Katsusuke Nabeshima
(Tokushima Univ.)
Katsuyoshi Ohara (Kanazawa Univ.)
Shinichi Tajima (Univ. of Tsukuba)
Computing parametric Bernstein-Sato ideals and holonomic D-modules 15

Summary: A computation method of comprehensive Gröbner systems is introduced in Poincaré–Birkhoff–Witt (PBW) algebras. Their applications to Bernstein–Sato ideals are considered. The resulting method gives holonomic D-modules associated with primary components of Bernstein–Sato ideals and roots of b-functions. Furthermore, with our implementation, effective methods are illustrated for computing holonomic D-modules associated with hypersurface singularities and quasihomogeneous singularities of complete intersections. It is shown that the proposed method is full of versatility.

Summary: An algorithm for computing Grothendieck local residues are developed. Grothendieck local residue is interpreted as a distribution represented by a Noether differential operator. Our method returns Noether operators.
Let I be an ideal generated by n polynomials of complex n variables. When the ideal I is 0-dimensional, our method exactly computes the Noether operator for the cohomology class whose denominator is the product of given polynomials.

Summary: In this talk, we show that the reduced standard bases of submodules of a free module of finite colength can be computed using Matlis duality. As applications, we can compute the Hilbert–Samuel multiplicities of primary ideals, and the Milnor numbers, the Tjurina numbers, and the versal deformation of isolated complete intersection singularities.

Summary: We introduce and characterize Bloch functions on bounded symmetric domains, which may be infinite dimensional, by extending several well-known equivalent conditions for Bloch functions on the open unit disc U in $\mathbb{C}$. We also generalize a number of results concerning Bloch functions on U to bounded symmetric domains.

Summary: Given a holomorphic mapping φ between bounded symmetric domains $\mathbb{B}_X$ and $\mathbb{B}_Y$, we derive criteria for boundedness and compactness of the composition operator C_φ between the Bloch spaces $\mathcal{B}(\mathbb{B}_Y)$ and $\mathcal{B}(\mathbb{B}_X)$, extending several known results for finite dimensional domains.

15 Hidetaka Hamada (Kyushu Sangyo Univ.) Weighted composition operators from H^∞ to the Bloch space of bounded symmetric domains 15

Summary: Let $\mathbb{B}_X$ be a bounded symmetric domain realized as the open unit ball of a JB*-triple X. In this talk, we characterize the bounded weighted composition operators from the Hardy space $H^\infty(\mathbb{B}_X)$ into the Bloch space on $\mathbb{B}_X$. We also give estimates on the operator norm. The lower estimate is an improvement of the result known. We show that the bounded multiplication operators from $H^\infty(\mathbb{B}_X)$ into the Bloch space on $\mathbb{B}_X$ are precisely those whose symbols are bounded. We also determine the operator norm of the bounded multiplication operator. As a corollary, we show that there are no isometric multiplication operators. Finally, we show that there are no isometric composition operators.

16:20–17:20 Talk Invited by Complex Analysis Section

Katsuhiko Matsuzaki (Waseda Univ.) Teichmüller spaces of circle diffeomorphisms

Summary: The Teichmüller space of a Riemann surface is a deformation space of complex structures on it and it has been studied in several fields of mathematics. However, in the framework of the quasiconformal theory of Teichmüller spaces, we can also introduce Teichmüller spaces of self-homeomorphisms of the circle with various regularities as subspaces of the universal Teichmüller space. In this talk, we focus on circle diffeomorphisms with α-Hölder continuous derivatives, and characterize such a mapping in terms of the complex dilatation of its quasiconformal extension and the Schwarzian derivative given by the Bers embedding. Then we provide a complex Banach manifold structure for this Teichmüller space and verify fundamental properties concerning this space. This includes to show that its topology coincides with the one induced by local $C^{1+\alpha}$-topology at the base point, and that it also has the structure of a contractible topological group.

The Teichmüller space of symmetric homeomorphisms of the circle defines a Banach foliated structure of the universal Teichmüller space. This space plays an important role in the theory of asymptotic Teichmüller spaces and contains the Teichmüller space of circle diffeomorphsms. We prove a certain rigidity of representations by symmetric conjugation in the group of circle diffeomorphisms with Hölder continuous derivatives, and demonstrate several applications. We also consider Teichmüller spaces of integrable symmetric homeomorphisms, which induce another Banach foliated structure and the generalized Weil–Petersson metric on the universal Teichmüller space. With a help of these spaces, we investigate conditions for a group of circle diffeomorphisms with Hölder continuous derivatives to be conjugate to a Möbius group by a diffeomorphism of the same regularity.

March 25th (Sat) Conference Room VII

9:40–11:50

16 Makoto Abe (Hiroshima Univ.) Gou Nakamura (Aichi Inst. of Tech.) Strong disk property for domains in open Riemann surfaces 10

Summary: We study the relation between the holomorphic approximation property and the strong disk property for an open set of an open Riemann surface or a Stein space of pure dimension 1.

Summary: Fixing a topological type of a normal surface singularity, which is an integral homology sphere link of degree one, we compute fundamental analytic invariants of possible complex structures supported on it.

Summary: We discuss about Bonk's distortion theorem in this talk. As an application, we derive a lower bound of the Bloch constant for various classes of locally biholomorphic Bloch mappings on a bounded symmetric domain in $\mathbb{C}^n$.

Summary: In general, the Beurling theorem does not hold for an invariant subspace in the Hardy space over the bidisk. In 1991, Nakazi posed a conjecture that the Beurling theorem holds for a singly generated invariant subspace. In this paper, a relation between a singly generated invariant subspace and a weighted Hardy space over the bidisk is studied. It is showed that there exists a weighted Hardy space over the bidisk which has a non-cyclic reproducing kernel. Also a counterexample for Nakazi's conjecture is given.

Summary: In this talk, we discuss proper holomorphic self-mappings of generalized complex ellipsoids and generalized Hartogs triangles and announce that, by using our previous results, we can obtain natural generalizations of some results due to Landucci, Chen–Xu and Zapalowski.

Summary: In this talk, we consider holomorphic automorphisms of quasi-circular domains fixing the origin in $\mathbb{C}^2$. It is known that every origin-preserving automorphism of a quasi-circular domain is a polynomial mapping. We classify the possibilities for the degrees $(\deg f_1, \deg f_2)$ of such polynomial automorphisms $f = (f_1, f_2)$ for quasi-circular domains in $\mathbb{C}^2$.

22 Genki Hosono (Univ. of Tokyo), Takayuki Koike (Kyoto Univ.) — On minimal singular metrics of line bundles whose stable base locus admits holomorphis tubhular neighborhoods 15

Summary: Let X be a projective complex manifold, L be a holomorphic line bundle on X, and $Y = \mathrm{SB}(L)$ be the stable base locus of L. In this situation, a minimal singular metric on L is locally bounded on $X \setminus Y$. We are interested in the behavior of minimal singular metrics around Y. We investigate it in the conditions that Y is a non-singular manifold and the normal bundle $N_{Y/X}$ can be written as a direct sum of negative line bundles. An important example satisfying these conditions is Nakayama's example. The second speaker showed that, in Nakayama's example, we can describe minimal singular metrics using certain convex set defined by L and $N_{Y/X}$. In this talk, we extend this result to more general situation. As an example, we give a higher codimensional generalization of Zariski's example of nef big line bundle which is not semi-ample.

23 Kazuko Matsumoto (Tokyo Univ. of Sci.) — Takeuchi's equality for the Levi form of the Fubini-Study distance to complex submanifolds in $\mathbf{CP}^n$ 15

Summary: In 1964, A. Takeuchi showed that the negative logarithm of the Fubini-Study boundary distance function of pseudoconvex domains in the complex projective space $\mathbf{CP}^n$ is strictly plurisubharmonic and solved the Levi problem for $\mathbf{CP}^n$. His estimate from below of the Levi form is nowadays called Takeuchi's inequality. In this talk, we give Takeuchi's equality, i.e., an explicit representation for the Levi form of the negative logarithm of the Fubini-Study distance to complex submanifolds in $\mathbf{CP}^n$.

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

Masanori Adachi (Tokyo Univ. of Sci.) — Function theory on Levi-flats: case study on flat circle bundles

Summary: One of long standing problems in several complex variables is the generalized Levi problem, which asks the existence of certain holomorphic functions on domains with pseudoconvex boundary in complex manifolds. Although the affirmative answer to strongly pseudoconvex boundary case is classical, our understanding is insufficient for weakly pseudoconvex boundary case, in particular, Levi-flat boundary case. For instance, the non-existence conjecture of smooth closed Levi-flat real hypersurface in complex projective plane is still open in spite of several clever attempts.

In this talk, we would like to report recent progress on the theory of analytic functions on Levi-flat bounded domains and Levi-flat CR manifolds. The talk will consist of kinds of case study on flat circle bundles: Kodaira type embedding of Levi-flat CR manifolds, geometric interpretation and analytical aspects of the Diederich–Fornaess index, and non-vanishing of weighted Bergman spaces of Levi-flat bounded domains.

Part of this talk is based on joint work with Judith Brinkschulte.

Functional Equations

March 24th (Fri) Conference Room I

9:30–12:00

1 Ichiro Tsukamoto (Toyo Univ.)♭ Asymptotic behaviour of positive solutions of $x'' = t^{\alpha\lambda-2}x^{1+\alpha}$ in the remaining cases ····· 10

Summary: Taking the technique used in the previous papers, we have the domain of the positive solutions of $x'' = t^{\alpha\lambda-2}x^{1+\alpha}$ and analytical expressions of these in the neighbourhoods of the ends of the domain, even in the remaining cases.

2 Yoshiaki Goto (Otaru Univ. of Commerce)
Keiji Matsumoto (Hokkaido Univ.) Irreducibility of the monodromy representation of Lauricella's F_C ···· 12

Summary: We study the monodromy representation of Lauricella's hypergeometric function F_C. In this talk, we would like to give an elementary proof of irreducibility of the monodromy representation. To prove it, we use the intersection matrix and characterizations of circuit transformations in terms of twisted homology groups.

3 Junya Nishiguchi (Kyoto Univ.) A necessary and sufficient condition for well-posedness of initial value problems of retarded functional differential equations ····· 12

Summary: We would like to discuss the delay structure of the dynamics of delay differential equations (DDEs). This means the dynamical systems generated by DDEs are not formulated on the space of dependent variable x but on the space of histories of an unknown function $x(\cdot)$. This viewpoint was brought by Hale introducing the retarded functional differential equations (RFDEs). In this talk, we introduce RFDEs with general delay structure to treat various DDEs in a unified way and to clarify the delay structure in those dynamics. We are interested in the question as to which space of histories is suitable for the topological dynamics of each DDE, and investigate the well-posedness of the initial value problems (IVPs) of the RFDEs. A main theorem is that the IVP is well-posed for any admissible history functional if and only if the semigroup determined by the trivial RFDE is continuous.

4 Shogo Yamanaka (Kyoto Univ.) Local analytic integrability of Poincaré–Dulac normal forms ····· 12

Summary: We consider systems of equations with an equilibria at the origin. We prove that normal forms are integrable if the resonance degree is 0 or 1 and that they can be non-integrable if the resonance degree is greater than 1. This result is similar to that of Birkhoff normal forms. We also show that there is a gap between analytic and meromorphic non-integrability.

Summary: The Pease model is known as one of the mathematical models describing an epidemic of type A influenza. This model deals with an epidemic dynamics of one kind of influenza. However, we know that two kinds of type A influenza (the seasonal type and the pandemic type) can spread in the actual epidemic. In this presentation, we propose a generalized Pease model in which two kinds of type A influenza may be simultaneously epidemic, and show the existence of the stationary solution and persistence of the influenza under certain assumptions.

Summary: In this article we consider the following non-linear difference equation $x(n+1)-x(n)+f(x(n-k_1)),x(n-k_2),\cdots,(n-k_m))=0$ and a linear difference equation$y(n+1)-y(n)+\sum_{i=1}^{m}p_iy(k-k_i)$. And also we give an extension of Kocic and Ladas's oscillatory theorem of the the above non-linear difference equation.

Summary: In this talk we deal with the following SI model $x(n+1)=x(n)(1-b)+(1-x(n))(1-e^{-ax(n-1)})$ with $a>1$ and $0<b<1$ and show results on the globally asymptotically stable.

Summary: We consider the global behavior of bifurcation curves for nonlinear ordinary differential equations with oscillatory nonlinear term. We treat the case where λ is parameterized by the maximum norm $\alpha=\|u_\lambda\|_\infty$ of the solution u_λ associated with λ and is written as $\lambda=\lambda(\alpha)$. Moreover, we focus on the case where $\lambda(\alpha)\to\pi^2/4$ as $\alpha\to\infty$. We establish the asymptotic formulas for $\lambda(\alpha)$ with the exact second terms.

Summary: We introduce a new method for solving general initial value problems by using the theory of reproducing kernels. The results are depending on the specific structure of each problem. Here, we give the general principle of the method and illustrate it with simple prototype examples. On the basis of the process, we have certain integral transforms, which are generated by each specific initial value problem, and need to be analysed.

10 Saburou Saitoh (Gunma Univ.*/Inst. of Reproducing Kernels) Sandra Pinelas (Academia Militar) ♭ Division by zero z/0=0 and differential equations 5

Summary: In this talk, we will show and give fundamental applications of the division by zero $z/0 = 0/0 = 0$ in calculus and differential equations. In particular, we will introduce several fundamental concepts on calculus and differential equations, and we will know that the division by zero is our elementary and fundamental mathematics.

14:15–16:15

11 Takashi Kajiwara (Tokyo Metro. Univ.) Existence of a heteroclinic solution to the FitzHugh–Nagumo type reaction-diffusion system with heterogeneity 12

Summary: Chen, Kung and Morita studied a variational problem corresponding to the FitzHugh–Nagumo type reaction-diffusion system (FHN type RD system), and they proved the existence of a heteroclinic solution to the system. Motivated by the work by Chen, Kung and Morita, we consider a variational problem corresponding to FHN type RD system which involves heterogeneity. We prove the existence of a heteroclinic solution to the problem under certain conditions on the heterogeneity. Moreover, we give some information about the location of the transition layers.

12 Kazuyuki Yagasaki (Kyoto Univ.) Shotaro Yamazoe (Kyoto Univ.) Bifurcation of equilibria in infinite-dimensional Hamiltonian system and its application to nonlinear Schrödinger equation 12

Summary: The infinite-dimensional Hamiltonian system with symmetry-breaking perturbation are considered. We assume that the unperturbed system has an equilibrium and symmetries. When they are perturbed, some symmetries are broken but the rest of them persist. In this situation the equilibrium of unperturbed system may persist and its stability may switch. In this talk, we give bifurcation results for equilibrium. Some applications for standing waves of nonlinear Schrödinger equation are also presented as examples.

13 Megumi Sano (Osaka City Univ.) Futoshi Takahashi (Osaka City Univ.) Sublinear eigenvalue problems with singular weights related to the critical Hardy inequality 10

Summary: In this talk, we consider a weighted sublinear eigenvalue problem related to an improved critical Hardy inequality. We discuss to what extent the weights can be singular for the existence of weak solutions. Also we study the asymptotic behavior of the first eigenvalues as a parameter involved varies.

14 Megumi Sano (Osaka City Univ.) Minimization problems related to generalized critical Hardy inequalities on a bounded domain 12

Summary: On a bounded domain Ω, we consider the minimization problem associated with the optimal constant of generalized critical Hardy inequalities in the boundary singularity case and other cases. Especially, in the boundary singularity case, we show that the validity of the inequality depends on the sharpness of the corner of the domain Ω. We also reveal the explicit optimal constant and its minimizers of the inequalities on balls.

Summary: We consider minimization problem on the Hardy–Sobolev inequality in boundary singularity case. In lower dimension case, we don't know the attainability of the best constant. In this talk, we study existence and nonexistence of the minimizer of the best constant.

Summary: In this talk, we consider a two-phase eigenvalue problem on thin domains. We show how the discontinuity of the coefficients and the shape of the interface affects the behavior of the eigenvalues.

Summary: We choose the shape of an elastic body as follows: we think of the corresponding three-dimensional cylinder with base an arbitrary two-dimensional simply connected bounded open set in $\mathbb{R}^2$ with sufficient smooth boundary. If this elastic body is isotropic and uniform, one may describe its oscillations using the Lamé operator. Assuming the oscillations are periodic, in this presentation we will talk about some properties of the eigenvalues of the elliptic Lamé operator of this straight elastic body as it gets thiner.

Summary: We consider a class of quasilinear elliptic partial differential operators $\mathcal{A}$ involving Δ_p as a typical example. Then we establish various typ of Kato's inequalities for them when $\mathcal{A}u$ is a measure. As application we prove the strong maximum principle, the inverse maximum principle and existence of admissible solutions for boundary value problems involving $\mathcal{A}$ with measure data.

Summary: In this talk, we consider the positivity for nontrivial nonnegative solutions of an indefinite sublinear elliptic equation with the Neumann boundary condition. Our approach relies on a bifurcation technique based on the Lyapunov-Schmidt reduction and sub and supersolutions.

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

Kazuki Hiroe (Josai Univ.) Around accessory parameters of linear ordinary differential equations

Summary: In this talk, we will look around several aspects of accessory parameters of linear ordinary differential equations. Firstly, we will review the way how the accessory parameters relate to Euler's integral representations of solutions of linear ODEs. Secondly, we will study a geometry of accessory parameters. More precisely, the space of accessory parameters of linear ODEs can be seen as the moduli space of meromorphic connections on vector bundles. When the vector bundles are trivial and singular points of connections are at most unramified, we will see that the moduli space can be realized as a Nakajima quiver variety. Finally we will discuss a similarity of the accessory parameter with the Euler characteristic of algebraic curves. From linear ODEs, we will define algebraic curves, which will be called "spectral curves", and compare invariants of them and discuss mysterious similarities.

March 25th (Sat) Conference Room I

9:30–12:00

20 Shun Kodama Concentration phenomena of least energy solutions to several singularly perturbed elliptic problems with a totally degenerate potential ····· 12

Summary: In this talk, I introduce the concentration phenomena of least energy solutions to two elliptic problems with a totally degenerate potential. In particular, our proof does not need a so-called uniqueness-nondegeneracy assumption on the limiting equation.

21 Shoichi Hasegawa (Tohoku Univ.) Two critical exponents for a Hénon type equation on the hyperbolic space ····· 12

Summary: In this talk, we shall discuss the existence of two critical exponents for a Hénon type equation on the hyperbolic space. For the Lane–Emden equation on the hyperbolic space, there exist no critical exponents on the positivity and stability of radial solutions. However, we have obtained a critical exponent on the existence of stable solutions of a weighted Lane–Emden equation on the hyperbolic space. We devote this talk to showing the existence of two critical exponents with respect to the sign of radial solutions to the Hénon type equation on the hyperbolic space. Moreover, we shall state some results on the classification of radial solutions by those asymptotic behavior.

22 Satoshi Tanaka (Okayama Univ. of Sci.) Symmetry-breaking bifurcation for the one-dimensional Hénon equation ····· 12

Summary: We show the existence of a symmetry-breaking bifurcation point for the one-dimensional Hénon equation

$$u'' + |x|^l u^p = 0, \quad u(-1) = u(1) = 0,$$

where $l > 0$ and $p > 1$. Moreover, employing an invariant of Rabinowitz's global bifurcation, we obtain the unbounded continuum (the first of the alternatives about Rabinowitz's global bifurcation), which emanates from the symmetry-breaking bifurcation point. Finally, we give an example of a bounded branch connecting two symmetry-breaking bifurcation points (the second of the alternatives about Rabinowitz's global bifurcation) for problems with the one-dimensional Hénon type equation.

Summary: We consider kernel estimates for analytic semigroups in $L^p(\mathbb{R}^N)$ generated by $\mathcal{L} = |x|^\alpha\Delta + c|x|^{\alpha-2}x\cdot\nabla - b|x|^{\alpha-2}$, where $N \in \mathbb{N}$, $1 < p < \infty$, $\alpha \in \mathbb{R}\setminus\{2\}$, $c \in \mathbb{R}$ and $b \in \mathbb{R}$ satisfy $b + (\frac{N-2+c}{2})^2 \geq 0$. Generation of analytic semigroups by $\mathcal{L}$ is given by Metafune–Okazawa–Sobajima–Spina. In this talk we discuss existence of the kernel and its upper estimate which forms a Gaussian estimate.

Summary: We study the solution $u(r,\rho)$ of the quasilinear elliptic problem

$$\begin{cases} r^{-(\gamma-1)}(r^\alpha|u'|^{\beta-1}u')' + |u|^{p-1}u = 0, \quad 0 < r < \infty, \\ u(0) = \rho > 0, \ u'(0) = 0. \end{cases}$$

The usual Laplace, m-Laplace, and k-Hessian operators are included in the differential operator $r^{-(\gamma-1)}(r^\alpha|u'|^{\beta-1}u')'$. Under certain conditions on α, β, γ, and p the equation has a singular positive solution $u^*(r)$ and the solution $u(r,\rho)$ is positive for $r \geq 0$. We study the intersection numbers between $u(r,\rho)$ and $u^*(r)$ and between $u(r,\rho_0)$ and $u(r,\rho_1)$. A generalized Joseph–Lundgren exponent p^*_{JL} plays a crucial role.

Summary: We consider the Cauchy problem of a Hamilton–Jacobi equation with the initial data of the Takagi function. The Takagi function is everywhere continuous and nowhere differentiable on $\mathbb{R}$, and the set of maximum points in $[0,1]$ of the Takagi function is uncountable. Our aim is to show that this Hamilton–Jacobi equation acts for the Takagi function with a beautiful corresponding structure. Here, by a corresponding structure, we mean that the time-evolution of the solution corresponds regularly to the decrease of level of partial Takagi functions.

Summary: A Hamilton–Jacobi equations with Caputo's time-fractional derivative of order less than one is considered. The notion of a viscosity solution is introduced to prove unique existence of a solution to the initial value problem under periodic boundary conditions. For this purpose comparison principle as well as Perron's method is established. Stability with respect to the order of derivative as well as the standard one is studied. Regularity of a solution is also discussed. Our results in particular apply to a linear transport equation with time-fractional derivatives with variable coefficients.

27 Hiroyoshi Mitake (Hiroshima Univ.)
Diogo A. Gomes (King Abdullah Univ. of Sci. and Tech.)
Hung V. Tran (Univ. of Wisconsin-Madison)
The Selection problem for discount Hamilton–Jacobi equations: some non-convex cases 12

Summary: We study the selection problem for the vanishing discount approximation of non-convex, first-order Hamilton–Jacobi equations. While the selection problem is well understood for convex Hamiltonians, the selection problem for non-convex Hamiltonians has thus far not been studied. We begin our study by examining a generalized discounted Hamilton–Jacobi equation. Next, using an exponential transformation, we apply our methods to strictly quasi-convex and to some non-convex Hamilton–Jacobi equations. Finally, we examine a non-convex Hamiltonian with flat parts to which our results do not directly apply. In this case, we establish the convergence by a direct approach.

28 Hiroyoshi Mitake (Hiroshima Univ.)
Kohei Soga (Keio Univ.)
The selection problem for discount Hamilton–Jacobi equations: rate of convergence 12

Summary: Weak KAM theory for discount Hamilton–Jacobi equations and corresponding discount Lagrangian/Hamiltonian dynamics is developed. Then it is applied to error estimates for viscosity solutions in the vanishing discount process. The main feature is to introduce and investigate the family of α-limit points of minimizing curves, with some details in terms of minimizing measures. In error estimates, the family of α-limit points is effectively exploited with properties of the corresponding dynamical systems.

13:30–14:30 Award Lecture for the 2016 MSJ Analysis Prize

Shigeaki Koike (Tohoku Univ.)
ABP maximum principle for L^p-viscosity solutions of fully nonlinear equations and its applications

Summary: We discuss on several results in a series of works with A. Święch (Georgia Institute of Technology) and recent developments.

After a brief introduction of the literature, we first show the ABP maximum principle for fully nonlinear elliptic/parabolic PDE with unbounded coefficients/inhomogeneous terms. We also deal with the case when PDE have superlinear growth in the gradient though we have counter examples in general.

As applications, we present weak Harnack inequality for elliptic/parabolic PDE. Thanks to the weak Harnack inequality, we obtain Hölder regularity, strong maximum principle and more. A key tool to show the weak Harnack inequality is to construct barrier functions, which will be mentioned in my talk. We also try to extend these to some quasilinear PDE with a singularity.

Some of the results are joint works with T. Kosugi, and A. Święch–S. Tateyama.

March 26th (Sun) Conference Room I

9:30–12:00

29 Tatsu-Hiko Miura (Univ. of Tokyo) Zero width limit of the heat equation on moving thin domains ····· 12

Summary: We study the behavior of a variational solution to the Neumann type problem of the heat equation on a moving thin domain which degenerates into a closed evolving surface as its width goes to zero. We show that, under suitable assumptions, the weighted average in the thin direction of the variational solution to the heat equation converges weakly in a function space on the evolving surface as the moving thin domain shrinks, and that the weak limit is a variational solution to a new type of linear diffusion equation on the evolving surface that involves the mean curvature and the normal velocity of the surface.

30 Junichi Harada (Akita Univ.) Boundary behavior for solutions of the heat equation with a nonlinear boundary condition ····· 10

Summary: We will discuss the blow-up solutions of the heat equation with a nonlinear boundary condition. A goal of this talk is to show the existence of the blow-up profile and to determine spacial singularities of the blow-up profile. This result improves and generalizes our previous results.

31 Masaaki Mizukami (Tokyo Univ. of Sci.) Boundedness and asymptotic stability in a fully parabolic two-species chemotaxis-competition model ····· 12

Summary: This talk is concerned with asymptotic bahavior of solutions to a fully parabolic two-species chemotaxis-competition model. This system describes a situation in which multi populations react on single chemoattractant. Moreover, we assume that both populations reproduce themselves, and mutually compete with the other, according to the classical Lotka–Volterra kinetics. Bai and Winkler proved asymptotic behavior in the system under some conditions and special setting in 2016. The main result of this talk asserts boundedness and asymptotic stability of solutions to the system under more sharp and general condition.

32 Takayoshi Ogawa (Tohoku Univ.) Hiroshi Wakui (Tohoku Univ.) Non-uniform bound and non-existence for time global solutions to a degenerate drift-diffusion equation with the mass critical exponent ··· 12

Summary: We show non-uniform bound and non-existence for time global solutions to a degenerate drift-diffusion equation with the mass critical exponent in higher dimensions under relaxed weight condition. If the entropy of the initial data is negative, the corresponding solution does not remain uniformly bounded in the energy class with respect to the time variable or does not exist globally in time under relaxed weight condition for the initial data. Moreover, we proved that the time global solution does not exist if the solution is radially symmetric without assuming the weight condition.

33 Keisuke Takasao (Univ. of Tokyo) Existence of weak solution and monotonicity formula for volume preserving mean curvature flow ····· 10

Summary: In this talk, we consider the Allen–Cahn equation with non-local term studied by Golovaty. In 2016, Takasao proved that the singular limit of the Allen–Cahn equation is the n-rectifiable set and the weak solution for the volume preserving mean curvature flow for $n = 1, 2$. We show the existence of the weak solution for the volume preserving mean curvature flow for $n \geq 2$ by using the monotonicity formula for the Allen–Cahn equation.

Summary: We study the reaction diffusion system on the fundamental chemical process of multi-species. This system is provided with many conservation laws. We obtain a global-in-time renormalized solution which converges to the unique spatially homogeneous steady state exponentially in L^1 norm. The proof relies on the entropy production concerning the diversity (relative entropy).

Summary: We study a parabolic equation with non-local term derived from the Gierer–Meinhardt system. In this system there is no quenching both in finite and infinite time. Some criteria for the global-in-time existence and the blowup of the solution are shown.

Summary: We consider the Cauchy problem of an an attraction-repulsion chemotaxis system in $\mathbb{R}^2$. The purpose of this talk is to give a sufficient condition that the nonnegative solution exists globally in time.

Summary: In this talk, we consider conservative forms and conservation laws of compressible fluid systems on an evolving surface. Applying them, we study the enthalpy, entropy, and free energy of compressble fluid on an evolving surface.

Summary: In this talk, we first introduce the explicit representation of the non-trivial stationary solution to the Kuramoto–Sakaguchi equation. Next, we discuss the sufficient condition for the existence of it in relation to the magnitude of some parameters.

14:15–16:15

Summary: We study the motion of isentropic gas in nozzles. The phenomena are governed by the compressible Euler equation. In this talk, we consider its unsteady flow and devote to proving the time global existence of solutions to the Cauchy problem for the general nozzle. The theorem has been proved in (Tsuge (2013)). However, this result is limited to small data. Our aim in the present paper is to remove this restriction, that is, we consider large data. The problem seems to lie in a bounded estimate of approximate solutions. To solve this, we first introduce a generalized invariant region, which depends on the space variable. Moreover, we develop a modified Godunov scheme to construct approximate solutions.

Summary: We consider the long-time behavior of solutions to the short-pulse equation. Using the method of testing by wave packets, we prove small data global existence and modified scattering.

Summary: We have constructed stationary axisymmetric solutions of the Euler–Poisson equations with small constant angular velocity with the adiabatic exponent γ in $(6/5, 3/2]$. The problem is formulated as a nonlinear integral equation, and is solved by iteration technique. We can show properties of the slowly rotating stars such as physical vacuum boundary, obleteness and so on.

Summary: In this talk, we would like to consider a resolvent problem on the upper half-space arising from a compressible fluid model of Korteweg type with free boundary condition. It is proved that there exist $\mathcal{R}$-bounded solution operator families of the resolvent problem in the following way: We first apply the partial Fourier transform with respect to the tangential variables x' to the resolvent problem in order to obtain ordinary differential equations with respect to x_N in the Fourier space. Secondly, we solve the ordinary differential equations. Thirdly, applying the inverse transform to the solution of ODEs gives the representation formula of solutions to the resolvent problem. Finally, we analyze the symbols (especially, Lopatinskii determinant) of the representation formula in detail in order to prove the existence of $\mathcal{R}$-bounded solution operator families mentioned above.

Summary: This talk is concerned with the stability of bifurcating solutions of the artifical compressible system. The incompresible Navier–Stokes system is obtained from the artificial compressible one in the zero Mach number limit which is a singular limit. Both systems have the same set of stationary solutions. It is shown that the stability structure of a bifurcating stationary solution of the artificial compressible system is the same as that of the incompressible system uniformly for small Mach numbers.

Summary: The energy decay problem is studied for the nonlinear dissipative wave equation $u_{tt} - u_{xx} + |u_t|^{p-1}u_t = 0$, where $x \in \mathbf{R}$ and $t > 0$. It is shown by Mochizuki and Motai (1995) that the decay rate is at least logarithmic when $1 < p < 3$. In this talk, an improvement is found which implies a polynomial decay rate for the same range of exponents.

45 Takuto Imai (Future Univ. Hakodate)
Hiroyuki Takamura (Future Univ. Hakodate)
Kyouhei Wakasa (Muroran Inst. of Tech.)
Masakazu Kato (Muroran Inst. of Tech.)
The sharp lower bound of the lifespan of solutions to semilinear wave equations with low power in two space dimensions 12

Summary: We consider a proof of the conjecture in Takamura (2015) on the lower bound of the lifespan of solutions to semilinear wave equationsin two space dimensions.The result is divided into two cases according to the total integral of the initial speed.

46 Yuta Wakasugi (Nagoya Univ.)
Motohiro Sobajima (Tokyo Univ. of Sci.)
Diffusion phenomena for the wave equation with space-dependent damping in an exterior domain 10

Summary: We consider the asymptotic behavior of solutions to the wave equation with space-dependent damping in an exterior domain. We prove that when the damping is effective, the solution is approximated by that of the corresponding heat equation as time tends to infinity. Our proof is based on semigroup estimates for the corresponding heat equation and weighted energy estimates for the damped wave equation. The optimality of the decay rate for solutions is also established.

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

Hisashi Nishiyama (Wakayama Univ.) Diffusion phenomena for damped wave equations

Summary: When the damping is sufficiently strong, the asymptotic property of the damped wave is similar to a solution of a heat equation. This type phenomenon is called the diffusion phenomena. In this talk, we study the diffusion phenomena by using stationary argument.

March 27th (Mon) Conference Room I

9:15–12:00

47 Shouta Enomoto (Kyushu Univ.)
Yoshiyuki Kagei (Kyushu Univ.)
Mohamad Nor Azlan
Stability of space-time periodic states to the compressible Navier–Stokes equation in an infinite layer 12

Summary: We consider the stability of space-time periodic states to the compressible Navier–Stokes equation in an infinite layer of R^n $(n = 2, 3)$. There exists a space-time periodic solution if the external force is space-time periodic and is sufficiently small in some Sobolev space. We show that if the initial perturbation is sufficiently small, the space-time periodic solution is asymptotically stable and the L^2 norm of perturbation decays $t^{-\frac{n-1}{4}}$ as $t \to \infty$. Furthermore, the asymptotic leading part is described by solutions of a 2 dimensional linear heat equation when $n = 3$, and by solutions of a 1 dimensional viscous Burgers equation when $n = 2$.

Summary: In this talk we consider the large time behavior of solutions to the compressible Navier–Stokes equations in a cylinder under slip boundary condition. It is shown that if the initial data is sufficiently small, the global solution uniquely exists and the large time behavior of the solution is described by a superposition of one-dimensional diffusion waves and an incompressible flow which decays purely diffusively.

Summary: We study the two dimensional Navier–Stokes initial boundary value problem in exterior domains assuming that the initial data u_0 belongs L^∞ with divergence free in the weak sense. The global in time unique existence of this problem is verified. The solution grows double exponentially when time goes to infinity.

Summary: We show existence theorem of global strong solutions with small initial data and external forces in the Besov space with both negative and positive differential orders which is an invariant space under the change of scaling. Our solution also belongs to the Serrin class in the usual Lebesgue space. The result on local existence and uniqueness of strong solutions for large data is also discussed. Our method is based on the maximal Lorentz regularity theorem of the Stokes equations in the homogeneous Besov spaces.

Summary: We consider the two-dimensional Navier–Stokes equations in an exterior domain, subject to the non-slip boundary condition. It is well known that there exist various non-trivial stationary solutions, which are asymptotically constant and with a finite Dirichlet integral. On the other hand, even local solvability was unknown for the non-stationary problem for such non-decaying initial data. In this talk, we report some global well-posedness result for bounded initial data with a finite Dirichlet integral, and existence of asymptotically constant solutions for arbitrary large Reynolds numbers.

Summary: We discuss the time periodic problem to the incompressible Navier–Stokes equations on the whole space $\mathbb{R}^n$, $n \geq 3$, with the external forces of non-divergence form. Firstly, we consider the existence of time periodic solutions in $BC(\mathbb{R}; L^{n,\infty}(\mathbb{R}^n))$ assuming the smallness of external forces in $BC(\mathbb{R}; L^1(\mathbb{R}^3))$ and $BC(\mathbb{R}; L^{\frac{n}{3},\infty}(\mathbb{R}^n))$ in the case $n \geq 4$. Next, we show that the mild solution above becomes a strong solution in $L^{n,\infty}(\mathbb{R}^n)$ with a natural condition of the external force, derived from the strong solvability of the inhomogeneous Stokes equations in $L^{n,\infty}(\mathbb{R}^n)$. For this aim, we re-construct a strong solvability of an abstract evolution equation where the associated semigroup is not strongly continuous at $t = 0$.

Summary: We give a refined blow-up criterion for solutions of the 3D Navier–Stokes equations with fractional Laplacian. The criterion is composed by the direction field of the vorticity and its magnitude simultaneously. Our result is an improvement of previous results H. Beirao da Veiga and L. Berselli (02), and D. Chae (07).

Summary: It is not well known whether or not turbulence relates directly to the Cauchy problem for the three dimensional incompressible Navier–Stokes equations. P. Constantin and C. Fefferman proved that if the disturbance of the direction vector of vorticity to the Navier–Stokes equations is small in regions of high vorticity on some time interval [0,T], then there is no singularity up to T. We investigate the behavior of the vector in Hatakeyama–Kambe's turbulence model by using numerical computation.

Summary: This talk deals with a two-species chemotaxis-Navier–Stokes system with logistic source. In the previous works e.g., by Winkler (2012), Lankeit (2016) and Tao–Winkler (2016), global existence and behaviour of solutions for 2D and 3D one-species chemotaxis-Navier–Stokes systems were studied. The present work asserts global existence and boundedness for the case of two species in 2D.

Summary: We consider the Keller–Segel system coupled with the Navier–Stokes fluid in the whole space, and prove the existence of global mild solutions with the small initial data in the scaling invariant space. Our method is based on the implicit function theorem which yields necessarily continuous dependence of solutions for the initial data. As a byproduct, we show the asymptotic stability of solutions as the time goes to infinity. Since we may deal with the initial data in the weak L^p-spaces, the existence of self-similar solutions provided the initial data are small homogeneous functions. This talk is based on a joint work with Professors H. Kozono (Waseda University) and Y. Sugiyama (Kyushu University).

Summary: In this talk, I talk about the L_p-L_q decay properties of solutions of the slightly perturbed Stokes equations with free boundary condition in an exterior domain. The space dimension is assumed to be 3 or more than 3. The decay rate for the velocity field and its gradient is the same as in the Cauchy problem case. Especially, the gradient estimate has no restriction for the exponents, which is different from the non-slip boundary condition case.

58 Yoshihiro Shibata (Waseda Univ.) Global wellposedness for the free boundary problem of the Navier–Stokes equations in an exterior domain 10

Summary: In this talk, I would like to report the global wellposedness of the free boundary problem for the Navier–Stokes equations without surface tension in an exterior domain of N dimensional Euclidean space $\mathbf{R}^N$ with $N \geq 3$. The idea is to use the local Lagrangian map to transform the time dependent domain to the reference domain. The local wellposedness was reported in the previous meeting held in the fall of 2016. To prove the global well-posedness, L_p-L_q decay estimate for the slightly perturned Stokes equations with free boundary condition plays an essential role.

14:15–16:15

59 Teppei Kobayasi (Meiji Univ.) The Green matrix and the Green formulas of the Stokes equations for a half space 12

Summary: In this talk, we consider the Green matrix and the Green formulas of the Stokes equations for a half space.

60 Ryosuke Hyakuna (Waseda Univ.) Well-posedness of the Hartree type equation 10

Summary: In this talk we discuss the local well-posedness of the Hartree type equation in $\widehat{L^p}$, where $\widehat{L^p}$ is the set of all functions whose Fourier transforms are in $L^{p'}$.

61 Gaku Hoshino (Waseda Univ.) Leibniz rule for pseudo-conformal generator and its application to analytic smoothing effect for non pseudo-conformally invariant nonlinear Schrödinger equations 12

Summary: We consider the Cauchy problem for non pseudo-conformally invariant Schrödinger equations. Especially, we study analytic smoothing effect by applying Leibniz rule for pseudo-conformal generator.

62 Masayuki Hayashi (Waseda Univ.)
Takahisa Inui (Kyoto Univ.)
Noriyoshi Fukaya (Tokyo Univ. of Sci.) Global well-posedness for a generalized derivative nonlinear Schrödinger equation 12

Summary: We prove global well-posedness for a generalized derivative nonlinear Schrödinger equation (gDNLS) by a variational argument. The variational argument is applicable to a cubic derivative nonlinear Schrödinger equation (DNLS). For (DNLS), Wu proved that the solution with the initial data u_0 is global if $\|u_0\|_{L^2}^2 < 4\pi$ by the sharp Gagliardo–Nirenberg inequality. The variational argument gives us another proof of the global well-posedness for (DNLS). Moreover, by the variational argument, we can show that the solution to (DNLS) is global if the initial data u_0 satisfies that $\|u_0\|_{L^2}^2 = 4\pi$ and the momentum $P(u_0)$ is negative.

63 Hideaki Sunagawa (Osaka Univ.)
Chunhua Li (Yanbian Univ.) Remarks on derivative nonlinear Schrödinger systems with multiple masses 12

Summary: We prove global existence of small solutions to the initial value problem for a class of cubic derivative nonlinear Schrödinger systems with the masses satisfying suitable non-resonance relations. The large-time asymptotics of the solutions are also shown. This work is intended to provide a counterpart of the previous work (Li–Sunagawa, 2016) in which the mass resonance case was treated.

Summary: We construct wave operators for nonlinear Schrödinger equations with inverse-square potentials via the energy methods.

$$i\frac{\partial u}{\partial t} = \Big(-\Delta + \frac{a}{|x|^2}\Big)u + g_0(u).$$

For instance we suppose $g_0(u) := u\,(|x|^{-\gamma} * |u|^2)$ or $g_0(u) := |u|^{p-1}u$. Hayashi–Tsutsumi (1987) constructed the wave operators for $a = 0$ and $g_0(u) := u\,(|x|^{-\gamma} * |u|^2)$. Our methods can be applied for $a \geq -(N-2)^2/4$ and both cases of $g_0(u)$.

Summary: The aim of this study is to establish the Strichartz estimates for wave equation with magnetic potentials to the initial-boundary value problem in an exterior domain outside the star-shaped obstacle. The fundamental tool is the Strichartz estimates for the free equation and the space-time weighted energy estimates.

Summary: We consider the final state problem for the nonlinear Schrödinger equation with homogeneous nonlinearity which is of the long range critical order and is not necessarily a polynomial, in one or two space dimensions. Asymptotic behavior of solutions to nonlinear Schrödinger equations with critical nonlinearities is determined by the shape of nonlinearities. For example, when the nonlinearity is a gauge invariant one, the solution asymptotically behaves like a modified free solution for large time, but if the nonlinearity is gauge variant, then the solution does not behave like that. In this talk, we give a sufficient condition for the shape of the homogeneous nonlinearity to construct the modified wave operator for our equation.

Summary: In this talk, we consider the long time behavior of solution to the nonlinear Klein–Gordon equation (NLKG) in two space dimensions with a gauge invariant quadratic nonlinearity. For a given asymptotic profile u_{ap}, we construct a solution u to (NLKG) which converges to u_{ap} as $t \to \infty$. Here the asymptotic profile u_{ap} is given by the leading term of the solution to the linear Klein–Gordon equation with a logarithmic phase correction. Construction of a suitable approximate solution is based on Fourier series expansion of the nonlinearity.

16:30–17:30 Award Lecture for the 2016 MSJ Analysis Prize

Soichiro Katayama (Osaka Univ.) Global existence and asymptotic behavior for systems of nonlinear wave equations

Summary: We consider the Cauchy problem for systems of nonlinear wave equations with small initial data in two and three space dimensions. We suppose that the nonlinear terms depend only on derivatives of the unknown functions. If the initial data and the nonlinear terms are smooth, the local existence of the classical solutions is well-known. However, even for small initial data, the blow-up of solutions may occur in finite time, and we need some restriction on the nonlinearity to obtain global solutions. In this talk, we firstly introduce a famous sufficient condition, called the null condition, for the global existence of small solutions. Then, we proceed to explore weaker sufficient conditions than the null condition. We will discuss these weaker conditions, and the asymptotic behavior of global solutions under these weaker conditions.

Real Analysis

March 26th (Sun) Conference Room VII

9:00–11:55

Summary: This paper is the part I of the series of the survey articles of the axiomatic method of measure and integration. In this paper, we study the definition and the existence theorem of d-dimensional Jordan measure.

Summary: This paper is the part II of the series of the survey articles of the axiomatic method of measure and integration. In this paper, we study the definition of Riemann integral and its fundamental properties.

Summary: We give a sufficient condition for the strict power concavity of a convolution. The condition is obtained by using Brascamp and Lieb's inequality. Using the result, we obtain the strict power concavity of Poisson's integral for the upper half space.

Summary: We formulate bang-bang, purification, and minimization principles in dual Banach spaces with Gelfand integrals and provide a complete characterization of the saturation property of finite measure spaces. We also present a new application of the relaxation technique to large economies with infinite-dimensional commodity spaces, where the space of agents is modeled as a finite measure space. We propose a "relaxation" of large economies, which is regarded as a reasonable convexification of original economies. Under the saturation hypothesis, the relaxation and purification techniques enable us to prove the existence of Pareto optimal allocations without convexity assumptions.

Summary: In general, L^p-spaces over finitely additive measures may not be complete. A finitely additive measure μ for which $L^p(\mu)$ is complete is characterized by the condition called the additive property. We consider a certain class of finitely additive measures constructed from ultrafilters and study a necessary and sufficient condition for such a measure to have the additive property.

Summary: In this talk we consider the principal value of Henstock–Kurzweil integral.

Summary: A generalization of the inclusion-exclusion integral to the nondiscrete case, which called upper and lower inclusion-exclusion integrals, is proposed. Moreover the integral is also generalized using the dual measure for enabling integration of functions which do not take positive values, but also negative values. All of these generalized integrals satisfy the basic appropriate properties as the integral.

Summary: The Krasnosel'skii–Mann (KM) iteration is a widely used method to solve fixed point problems and its theoretical convergence rates have been recently analyzed. We investigate convergence rates for the KM iteration in a Hilbert space.

Summary: In this talk, we prove nonlinear mean convergence theorems for a family of nonlinear mappings related to hybrid mappings by using the ideas of attractive points and acute points. We also prove weak and strong convergence theorems for the family by some iterative methods.

Summary: We will talk about yet another generalization of the Banach contraction principle.

Summary: Pérez investigated the weighted inequalities for fractional integrals which are related to the Fefferman–Stein inequality. In this talk, we discuss the Pérez inequality on weighted Morrey spaces.

14:15–16:50

Summary: We discuss the trace operators of Wiener amalgam spaces using frequency-uniform decomposition operators and maximal inequalities, obtaining sharp results. Additionally, we provide the embeddings between standard and anisotropic Wiener amalgam spaces. This talk is based on collaborated work with Y. Tsutsui.

Summary: The aim of this paper is to consider the non-smooth decomposition of Morrey spaces. The atom in this talk will be a function that belongs to certain Morrey spaces. As an application, we show that the Olsen inequality is available.

Summary: Morrey spaces are equipped with two parameters p and q. Here we aim to consider the complex interpolation of two Morrey spaces under a certan condition.

Summary: Here we propose a framework within which we hand the Fourier transform in Morrey spaces. We name it Fourier Morrey spaces. We describe the behavior of the Fourier transform on Morrey spaces.

Summary: On generalized martingale Morrey spaces we give necessary and sufficient conditions for the boundedness of generalized fractional integrals as martingale transforms.

Summary: The von Neumann Jordan constant of Banach spaces was introduced by Clarkson in 1937. Several mathematicians have studied the notion of the von Neumann Jordan constant of Banach spaces. The constant has been determined or estimated for various spaces. In this talk, we study (modified) von Neumann–Jordan constant and Zbaganu constant of $\pi/2$–rotation invariant norms on R^2.

Summary: Tingley's problem is an open problem in Banach space theory that asks whether every surjective isometry between the unit spheres of two Banach spaces extends to a real-linear isometric isomorphism. The problem is simple, but we do not have a complete answer even to the two-dimensional case. In this talk, the solution to Tingley's problem on finite von Neumann algebras is given.

19 Hiroyasu Mizuguchi (Niigata Univ.) The difference between two orthogonality notions in Radon planes ··· 15

Summary: The notion of orthogonality in inner product spaces is simple, useful and interesting. When moving to normed space, we have many possibilities to extend this notion. In a normed space X with more than three dimension, Birkhoff orthogonality is symmetric if and only if the space X is an inner product space. In two dimensional normed space, the symmetry of Birkhoff orthogonality is not necessarily equivalent to the existance of an inner product. A two dimensional normed space in which Birkhoff orthogonality is symmetric is called a Radon plane. We treat a constant $IB(X)$ which measure the difference between Birkhoff and isosceles orthogonalities. For any normed space X, the equality $1/2 \leq IB(X) \leq 1$ holds. Under the assumption that X is a Radon plane, we estimate $IB(X)$.

20 Kichi-Suke Saito (Niigata Univ.) Matrix norm of James constant and its applications ····· 15
Naoto Komuro
(Hokkaido Univ. of Edu.)
Ryotaro Tanaka (Kyushu Univ.)

Summary: In this talk, we introduce rotation invariant norms on two-dimensional real normed space. In particular, we consider the structure of rotation invariant norms. Using it, we present new formula of the James constant. As the application, we present several properties of James constant.

21 Mikio Kato (Kyushu Inst. of Tech.*) Some recent results on direct sums of Banach spaces ····· 15
Takayuki Tamura (Chiba Univ.)

Summary: We shall discuss A-direct sums which were recently formulated in Dhompongsa–Kato–Tamura (Linear Nonlinear Anal. **1**, 2015) as a more general notion than ψ- and Z-direct sums. We shall note that all these direct sums are in fact isometrically isomorphic. Some previous results for ψ- and Z-direct sums will be generalized to the A-direct sum setting. In particular a sequence of recent results concerning the problem on uniform non-squareness raised in Kato–Saito–Tamura (Math. Inequal. Appl.**7**, 2004) will be presented.

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

Kenjiro Yanagi (Josai Univ.) Entropy in classical or quantum information theory

Summary: In this talk we will review on classical or quantum information sciences. In classical case we state some properties of Shannon entropy and relative entropy. We also define information channels and obtain some results of capacity of discrete time Gaussian channels with feedback. In quantum case we state some properties of von Neumann entropy and Umegaki relative entropy. We also introduce classical-quantum channels which was given by Holevo. At last we give the recent results related to skew information which are the extensions of Heisenberg or Schrodinger uncertainty relations and obtain some trace inequalities.

March 27th (Mon) Conference Room VII

9:00–11:40

22 Takanobu Hara (Tokyo Metro. Univ.) The Wolff potential estimate for solutions to elliptic equations with signed data 15

Summary: We give a new proof of pointwise Wolff potential estimates for solutions to p-Laplacian type equations with measure data $-div\mathcal{A}(x, \nabla u) = \mu$ in $\Omega \subset \mathbf{R}^n$. Our proof is based on the Poisson modification technique of Trudinger and Wang and an iteration method of Kilpeläinen and Malý.

23 Masaaki Mizukami ♭ (Tokyo Univ. of Sci.)
Tomomi Yokota (Tokyo Univ. of Sci.) A unified method for boundedness in Keller–Segel systems with signal-dependent sensitivity 15

Summary: This talk is concerned with asymptotic bahavior of solutions to a fully Keller–Segel model with signal-dependent sensitivity. In the case that the signal-dependent function is given by K/v, Fujie established global existence of bounded solutions under some smallness condition for K in 2015. On the other hand, in the regular type sensitivity case $K/(1+v)^k$ with $k > 1$, Winkler asserted global existence of bounded solutions for arbitrary $K > 0$ in 2010. However, there is a gap in the proof. Moreover, the condition in the regular type sensitivity case cannot connect to the condition in the singular sensitivity case. The purpose of the present talk is to obtain global existence and boundedness under more natural and proper condition for the signal-dependent sensitivity and to build a mathematical bridge between the singular sensitivity cases and regular type sensitivity.

24 Shunsuke Kurima (Tokyo Univ. of Sci.)
Tomomi Yokota (Tokyo Univ. of Sci.) Existence of solutions to nonlinear diffusion equations and their approximations with error estimates 15

Summary: This talk deals with nonlinear diffusion equations and their approximate equations under homogeneous Neumann boundary conditions in a general domain with smooth bounded boundary. Colli–Fukao (2016) studied similar equations in a bounded domain of two or three dimensional spaces. The present work asserts that we can solve the original problem and the approximate problem individually and directly in a general domain of N-dimensional spaces.

25 Takanori Kuroda (Waseda Univ.)
Mitsuharu Ôtani (Waseda Univ.) Finite time blow-up for a Ginzburg–Landau equation without linear term 15

Summary: We consider the following complex Ginzburg–Landau equation (CGL) without linear term.

$$u_t - e^{i\theta}[\Delta u + |u|^{q-2}u] = 0, \quad \text{on } [0,T) \times \Omega,$$

where $\theta \in (-\frac{\pi}{2}, \frac{\pi}{2})$ and i denotes the imaginary unit, $\Omega \subset \mathbb{R}^N$ is a bounded domain, and $T > 0$. In this talk we investigate an asymptotic behavior of solutions of (CGL), especially finite time blow-up. It was shown by Cazenave et al, that finite time blow-up could occur for initial data with negative energy. It is shown that the finite time blow-up could occur also for initial data with positive energy by using the so-called potential-well method.

Summary: We consider the maximality of sum of two maximal monotone operators A and B in a real Hilbert space H. In Brézis–Crandall–Pazy (1970), they showed that $A+B$ becomes a maximal monotone operator if $D(A) \subset D(B)$ and $|Bu|_H \leq k|Au|_H + \ell(|u|_H)$ $(\forall u \in D(A))$ are satisfied, where $k \in [0,1)$ and ℓ is a non-negative and non-decreasing function. In this talk, we present another sufficient condition with some angular property between A and B, by which we can give a generalization of the result by Brézis–Crandall–Pazy (1970). In addition, we exemplify some applications of our main result.

Summary: We consider the well-posedness for semilinear functional differential equations in a Banach space. The well-posedness is established under a semilinear stability condition with respect to a metric-like functional and a subtangential condition. In this talk, we apply the abstract result to a size-structured model with birth delay.

Summary: We consider the nonhomogeneous Dirichlet problem for scalar conservation laws with multiplicative noise on a bounded domain D:

$$du + \operatorname{div}(A(u))\, dt = \Phi(u)\, dW(t) \qquad \text{in } D \times (0,T)$$

We introduce a notion of renormalized kinetic formulations in which the kinetic defect measures on the boundary of a domain are truncated. In such a kinetic formulation we establish a result of well-posedness of the initial-boundary value problem under only the natural assumptions.

Summary: This talk is concerned with solvability of Vlasov–Poisson systems in a half-space with external magnetic force horizontal to a wall. In 2013, an existence result on a time interval $(0,T)$ was obtained by Skubachevskii. Moreover, in 2015, the system was solved with time T very large or infinite. The purpose of this talk is to establish solvability where the magnetic force has errors in a vertical direction to the wall.

30 Hiroshi Watanabe (Oita Univ.) Global solutions to nonlocal strongly degenerate parabolic systems with variable coefficients 15

Summary: We consider the initial value problem (CP) for nonlocal strongly degenerate parabolic systems with variable coefficients. The systems are coupled with strongly degenerate parabolic equations with respect to nonlocal quantities. Strongly degenerate parabolic equations are regarded as a linear combination of the time-dependent conservation laws (quasilinear hyperbolic equations) and the porous medium type equations (nonlinear degenerate parabolic equations). Thus, this equation has both properties of hyperbolic equations and those of parabolic equations. In this talk, we formulate BV-entropy solutions to (CP) and show the time global existence and uniqueness of the solutions.

31 Makoto Nakamura (Yamagata Univ.) On the derivation of several second order partial differential equations from the Einstein equation 10

Summary: A generalization of the Einstein equation is considered for complex line elements. Several second order semilinear partial differential equations are derived from it as semilinear field equations in uniform and isotropic spaces. The nonrelativistic limits of the field equations are also considered. The roles of spatial expansion and contraction are studied based on energy estimates of the equations, and several dissipative or antidissipative properties are remarked.

32 Makoto Nakamura (Yamagata Univ.) On the nonrelativistic limit of a semilinear field equation in uniform and isotropic space 10

Summary: The nonrelativistic limit of a semilinear field equation is considered in a uniform and isotropic space. The scale-function of the space is constructed based on the Einstein equation. The Cauchy problem for the limit-equation is considered, and global and blow-up solutions are shown in Sobolev spaces. The effects of spatial variance on the problem are studied.

14:15–16:25

33 Risei Kano (Kochi Univ.)
Takeshi Fukao (Kyoto Univ. of Edu.) The existence of solutions for the perfect plasticity model 15

Summary: In this talk, We discuss problems with the plastic deformation of materials. This problem has been discussed by many scholars. In particular, G. Duvaut and J. L. Lions showed the solutions of the evolution problem that has the constraints on threshold of stress, in 1976. We think about the solvability of the extended problem having the function f(t,x) of the threshold. Here follows the way of Duvaut–Lions, we talk about the existence of solutions of the parabolic approximation problem.

34 Ken Shirakawa (Chiba Univ.)
Hiroshi Watanabe (Oita Univ.)
J. Salvador Moll (Univ. Valencia)
Phase-field model of grain boundary motion including inhomogeneous Dirichlet type boundary condition 15

Summary: In this talk, a system of parabolic initial-boundary value problems is considered. This system is a modified version of the phase-field model of grain boundary motion, proposed by [Kobayashi et -al, Phys. D, 140 (2000), 141–150], and is derived as a gradient system of a governing energy, called free-energy. The novelty of this talk is found in the point that the free-energy includes a characteristic integral associated with the Dirichlet type boundary condition of the crystalline orientation, and our objective is to develop the mathematical method that enable to handle non-standard situations brought by the characteristic integral. Consequently, the results concerned with qualitative properties of our system will be reported in forms of some Main Theorems.

35 Ryota Nakayashiki (Chiba Univ.)
Ken Shirakawa (Chiba Univ.)
Allen–Cahn type equations involved in singular diffusions and dynamic boundary conditions 15

Summary: In this talk, we consider coupled systems of an Allen–Cahn type equation with singular diffusion in a bounded spatial domain Ω, and another Allen–Cahn type equation on the smooth boundary $\partial\Omega$. The systems are denoted by $(\mathrm{ACE})_\kappa$ with arguments $\kappa \geq 0$, and the coupled two Allen–Cahn type equations are transmitted via the dynamic boundary conditions. The objective of the study is to build a mathematical method to analyze the systems $(\mathrm{ACE})_\kappa$, for $\kappa \geq 0$, involved in singular diffusions and the dynamic boundary conditions. Consequently, the results concerned with the representations of solutions to $(\mathrm{ACE})_\kappa$, for each $\kappa \geq 0$, and the continuous dependence of $(\mathrm{ACE})_\kappa$ with respect to $\kappa \geq 0$, are reported in forms of some Main Theorems.

36 Takeshi Fukao (Kyoto Univ. of Edu.)
Noriaki Yamazaki (Kanagawa Univ.)
A boundary control problem for GMS model 15

Summary: In this talk, a boundary control problem for this equation and dynamic boundary condition of Cahn–Hilliard type is considered. This equation and dynamic boundary condition of Cahn–Hilliard type was introduced by Goldstein–Miranville–Schimperna (2011), this problem is called GMS model and it is similar to the general Cahn–Hilliard system. To find the optimal boundary control which realizes the minimal cost under a control constraint. Moreover, a necessary optimality condition is obtained.

37 Hirokazu Komatsu (Kinki Univ.)
Hiroyuki Nakajima (Kinki Univ.)
An analysis of ordinary differential equations that describe non-weakly reversible chemical reaction networks 15

Summary: Chemical reaction network theory (CRNT), which has been developed by M. Feinberg and his colleagues, provides a method for analyzing the ordinary differential equations (ODEs) that describe the time-evolutions of molar concentrations of species in chemical reaction networks. The most important result obtained from the CRNT is the Deficiency Zero Theorem (DZT), which guarantees the asymptotic stability of a unique equilibrium point on the positive stoichiometric compatibility class (PSCC) if the network is weakly reversible and its deficiency is zero. In this talk, we propose a method for analyzing ODEs that describe non-weakly reversible networks, of which a positive solution cannot be proved to converge to an equilibrium point based on the DZT. By decomposing the network into some weakly reversible subnetworks and applying the DZT to each of them, we show any positive solution converges to an equilibrium point on the boundary of the PSCC.

Summary: We deal with an initial value problem of a nonlinear system of ODEs, which is obtained from a biochemical reaction network constructed by cardiac hypertrophy factors. This mathematical model was proposed by A. Ito and K. Yamamoto in 2013. Until now it has already shown that our problem has one and only one global-in-time solution, which is nonnegative (resp. positive) for all time whenever the initial value is nonnegative (resp. positive). Moreover, the steady state system has one and only one nonnegative equilibrium point. The main purposes of this talk are to give the global boundedness of any solution starting from a sufficiently small initial value, which is also sufficiently close to the equilibrium point, and to show that the solution converges to the unique equilibrium point. The main idea is the Deficiency Zero Theorem which was shown by M. Feinberg in 1979.

Summary: In this talk, we consider a one dimensional free boundary problem as a mathematical model describing adsorption phenomenon in one hole of a porous media. This model consists of a partial differential equation for the relative humidity in the hole and an ordinary differential equation of the front of water drop region which represents the growth rate for water region. In this talk, we consider this model in each hole for each position of the porous media, and discuss the continuous dependence and the measurability of a solution of this problem with respect to the position of the porous media.

Summary: We consider a system of partial differential equations describing a mass conservation law for moisture in a porous medium. This type of systems can be found in concrete carbonation process and already proposed and studied by Kumazaki–Aiki. In the system the relationship between the relative humidity and the degree of saturation is described by a play operator. In this talk we consider the generalization of the system and show existence and uniqueness of a solution on a one-dimensional domain. By adopting the generalization we can describe various types of hysteresis as mentioned in Minchev–Okazaki–Kenmochi.

16:40–17:40 Talk Invited by Real Analysis Section

Yusuke Murase (Meijo Univ.) Analysis for brewing process of Japanese Sake and quasi-variational inequalities

Summary: Y. Murase and A. Ito proposed a mathematical model for brewing process of Japanese Sake, and analyzed the model. In 2013, we proved existence of solutions and existence of the finite stopping time with satisfying some satisfactory conditions for regularized simple model. In 2016 to 2017, we proved an existence of weak solutions for the model with stirring effect. he capital parts of our model with stirring effect are as follows.

$\theta_t - d_0\Delta\theta + \nabla\theta \cdot \mathbf{V} + g_0(\theta, u, v) = f_1$ a.e. in Q
$(u_1)_t - d_1\Delta u_1 + \nabla u_1 \cdot \mathbf{V} + g_1(\theta, u_1, u_2) = 0$ a.e. in Q
$(u_2)_t - d_2\Delta u_2 + \nabla u_2 \cdot \mathbf{V} + g_2(\theta, u_1, u_2) = 0$ a.e. in Q
$(u_1, u_2) \in K(\theta)$ a.e. in Q
$(v)_t - d_3\Delta v + \nabla v \cdot \mathbf{V} = -c_3 v u_1 + f_2$ a.e. in Q

This model contains a constraint condition which depends upon the solution self. It presents that the model corresponds to "Quasi-variational inequalities". "Quasi-variational inequalities" are variational inequalities whose constraint set depends on the unknown functions (solutions).
In this talk, we discuss existence of weak solutions, existence of optimal controls, numerical results, and we show you some supplemental information for quasi-variational inequalities.

Functional Analysis

March 24th (Fri) Conference Room IX

14:15–16:00

Summary: We consider the resonances of a two-by-two semiclassical system of one dimensional Schrödinger operators. One of the two potentials in the operator is bonding and the other one is anti-bonding. We consider the energy under the crossing of the potentials. We locate the resonances and obtain exponential bound on their widths whose indices are in proportion to Agmon distances of forbidden regions.

Summary: In this talk, we study the spectrum of a periodic Schrödinger operator on a zigzag super carbon nanotube, which is a generalization of the zigzag carbon nanotube. We see that its absolutely continuous spectrum has the band structure. Moreover, we see that its eigenvalues with infinite multiplicities consisting of the Dirichlet eigenvalues and points embedded in the spectral band for some corresponding Hill operator. We also introduce the results on the coexistence problem and the asymptotics for the spectral band edges.

Summary: The theory of hyperfunctions is established by M. Sato with purely algebraic methods. It is based on the theory of local cohomology groups with the coefficient in the sheaf of holomorphic functions, and as a consequence it cannot be easily understood. To overcome this difficulty, A. Kaneko and M. Morimoto gave the definition of hyperfunctions which is easy to understand intuitively. In our talk, we generalize their idea and construct a general framework of intuitive representation of local cohomology groups. This framework, for example, enables us to get intuitive expressions of Laplace hyperfunctions in several variables. This research is joint work with Kohei Umeta.

Summary: We have obtained the best constant of discrete Sobolev inequalities on C36. By giving appropriate indices on vertices of polyhedra and by introducing discrete Laplacians, We have obtained the pseudo Green matrices. The pseudo Green matrices are the reproducing kernels by setting appropriate vector spaces and inner products. By applying Schwarz inequality to the reproducing relations, the discrete Sobolev inequalities are obtained. The maximum of the diagonal values of pseudo Green matrices is the best constants of inequalities.

5 Toru Fuda (Hokkaido Univ.)
Daiju Funakawa (Hokkaido Univ.)
Akito Suzuki (Shinshu Univ.)
Localization and eigenvalues of a multi-dimensional quantum walk with one-defect. 15

Summary: We consider a multi-dimensional discrete-time quantum walk with one-defect. Our quantum walk model is defined by unitary operator U which is the product of a shift operator S and a coin operator C. Supposing that S and C are self-adjoint and unitary. We talk about the phenomenon called "localization". It is known that the localization occurs when U has eigenvalues. Our result is that U has eigenvalues with some sufficient conditions. This research is joint work with T. Fuda and A. Suzuki.

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

Koichi Kaizuka (Gakushuin Univ.) Stationary scattering theory for invariant differential operators on symmetric spaces of noncompact type

Summary: Characterizations of the joint eigenspaces of invariant differential operators have been one of the central problems in harmonic analysis on symmetric spaces. In 1970, Helgason conjectured that any joint eigenfunction on symmetric spaces of noncompact type is expressed as the image of the Poisson transform of an analytic functional on the boundary, and this conjecture was proved by Kashiwara et al. in 1978. After that, other image characterizations of the Poisson transform have been extensively studied by many people. In the previous work, the author proved the Strichartz conjecture concerning an image characterization of the Poisson transform with real and regular spectral parameter for the L^2-space on the boundary. In this talk, by developing weighted L^2-estimates on symmetric spaces of noncompact type, we extend the previous result to the case of real and singular spectral parameter. Roughly speaking, real and singular spectral parameter for invariant differential operators almost corresponds to that of threshold spectrum of a self-adjoint operator. In the real and singular case, a certain degeneracy appears in the scattering formula for the Poisson transform.

March 25th (Sat) Conference Room IX

9:00–12:00

6 Chungchuan Chen (Nat. Taichung Univ. of Edu.)
Topological dynamics on linear operators 15

Summary: Recently, linear dynamics was investigated by many authors. In this talk, we will introduce the concepts of topological transitivity, multiple recurrence and chaos as well. Some examples will be provided to explain the main idea for the result, first. Actually, we give sufficient and necessary conditions for a weighted translation operator on the Lebesgue space of a locally compact group to be transitive, multiply recurrent and chaotic in terms of the weight function, the Haar measure and the group element. These results subsume some previous related works.

7 Masaru Nagisa (Chiba Univ.)
Operator monotone rational function and its application 15

Summary: Let I be an open interval of the real line $\mathbb{R}$. When the function f is operator monotone on I and also rational, we can get the general form of f by elementary method. We consider the case f is operator monotone on I and meromorphic on the complex plane $\mathbb{C}$. In this case, we also get the similar general form of f. We will introduce some results related to this facts.

Summary: Let A and B be bounded positive invertible operators on a Hilbert space, and let $\Psi_{A,B}(t) \equiv A \natural_t B = A^{\frac{1}{2}}(A^{-\frac{1}{2}}BA^{-\frac{1}{2}})^t A^{\frac{1}{2}}$ $(t \in \mathbf{R})$. We consider the divided difference for $\Psi_{A,B}$. The first divided differences $\Psi^{[1]}_{A,B}(x,y)$ and $\Psi^{[1]}_{A,B}(x,x)$ are related to Tsallis relative operator entropy and generalized relative operator entropy, respectively. Recently, we have given the differences among relative operator entropies a viewpoint of operator divergences. In this talk, we regard $\Psi^{[1]}_{A,B}(x,y) - \Psi^{[1]}_{A,B}(x,x)$ as the 'first' operator divergence and discuss the n-th operator divergence defined by the n-th divided difference in general.

Summary: In this talk, we show operator versions of the inequality due to Cho, Matić and Pečarić in connection to Jensen's inequality for convex functions. As applications, we obtain an interpolation of the weighted arithmetic-geometric mean inequality for the Karcher mean of positive invertible operators on a Hilbert space.

Summary: We shall introduce some norm inequalities for matrix means. Exactly, we shall treat the power, Heron and Heinz means.

Summary: Corach–Porta–Lecht introduced the Finsler manifold of the positive invertible operators of a unital C*-algebra, which I extended it. The tangent vector of a geodesic in this geometry is the relative operator entropy we defined. Recently the Karcher mean for positive operators is related to this geometry and its equation is naturally based on the relative operator entropy. So, reviewing this, we discuss some relations around this geometry.

Summary: By the conditions related to the products and the spectral radius, we can characterize the real-algebra isomorphisms between unital semi-simple commutative Banach algebras A and B with symmetric involutions. In addition, we can unify and generalize some results proven individually. We will show that if $T : A \to B$ is a surjection with, for some $\alpha \in \mathbb{C} \setminus \{0\}$ and bijections $\rho : A \to A, \tau : B \to B$, $\mathrm{r(T(f)}\tau\mathrm{(T(g))} - \alpha) = \mathrm{r(f}\rho\mathrm{(g)} - \alpha)$ for all $f, g \in A$, then T is a real-algebra isomorphism.

Summary: A function space A on a compact Hausdorff space X is a linear subspace of $C(X)$ that contains constant functions and separate points of X. Let S be a surjective, not necessarily linear, isometry between two function spaces A and B. We show some properties of such an isometry.

Summary: We introduce semisimple commutative Banach algebras of type I and classify those algebras into four classes in terms of BSE and BED algebras. First we prove that one of four classes is characterized as the class of commutative C*-algebras. We give concrete examples of subclasses of the other three classes. Also, we show that the set of all semisimple commutative Banach algebras of type I corresponds to a semilattice of order 4 with respect to Lau product.

Summary: We give a characterization on a Hermitian operators on a Banach algebra of Lipschitz maps with values in a unital commutative C^*-algebras. As an application we give a characterization of a unital isometry on the algebra.

Summary: Let A_+^{-1} stand for the cone of all positive invertible elements in a unital C^*-algebras A. We give a characterization of commutativity for A via the gyrogroup operation on A_+^{-1}.

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

Kazuhiro Kawamura (Univ. of Tsukuba) Some Banach–Stone type theorems

Summary: We give a survey of recent results on Banach–Stone type theorems for isometries of continuous/C^1 function spaces. Characterizations of isometries of some function spaces in connection with topology/geometry of underlying spaces will be discussed.

March 26th (Sun) Conference Room IX

9:30–12:00

17 Sakaé Fuchino (Kobe Univ.) Pre-Hilbert spaces without orthonormal bases 15

Summary: Halmos proved in 1970's that there are pre-Hilbert spaces without orthonormal bases. His examples of such pre-Hilbert spaces are of dimension $\aleph_0$ and density κ for a cardinal κ with $\aleph_0 < \kappa \leq 2^{\aleph_0}$. We prove a set-theoretic characterization of pre-Hilbert spaces without orthonormal bases and show, using this characterization, that there are pre-Hilbert spaces without orthonormal bases and of dimension and density λ for any uncountable cardinal λ. The proof of the characterization theorem is a natural example of an application of the method of elementary submodels.

18 Kengo Matsumoto (Joetsu Univ. of Edu.) Relative Morita equivalence of C*-algebras and flow equivalence of topological Markov shifts 15

Summary: We will introduce notions of relative version of imprimitivity bimodules and relative version of strong Morita equivalence for pairs of C^*-algebras $(\mathcal{A}, \mathcal{D})$ such that $\mathcal{D}$ is a C^*-subalgebra of $\mathcal{A}$ satisfying certain conditions. We will then prove that two pairs $(\mathcal{A}, \mathcal{D})$ and $(\mathcal{A}', \mathcal{D}')$ are relatively Morita equivalent if and only if their relative stabilizations are isomorphic. In particularly, for two pairs $(\mathcal{O}_A, \mathcal{D}_A)$ and $(\mathcal{O}_B, \mathcal{D}_B)$ of Cuntz–Krieger algebras with their canonical masas, they are relatively Morita equivalent if and only if their underlying two-sided topological Markov shifts $(\bar{X}_A, \bar{\sigma}_A)$ and $(\bar{X}_B, \bar{\sigma}_B)$ are flow equivalent.

19 Yasuo Watatani (Kyushu Univ.) Tsuyoshi Kajiwara (Okayama Univ.) C*-algebras associated with complex dynamical systems or self-similar maps and their maximal abelian subalgebras and dimension groups of the cores 15

Summary: We consider C*-algebras associated with complex dynamical systems or self-similar maps. We study their maximal abelian subalgebras and dimension groups of the cores. By a concrere description of the matrix representations of their finite cores, we can investigate the endomorphisms of the dimension groups. In the case of the tent map, its dimension group is of infinite rank and the endomorphism is not surjective, which is different from the case of symbolic dynamical systems.

20 Tomohiro Kanda (Kyushu Univ.)[b] Taku Matsui (Kyushu Univ.) The existence and the uniqueness of regular KMS states on the resolvent CCR algebra 10

Summary: In 2008, D. Buchholz and H. Grundling defined the resolvent CCR algebra. The resolvent CCR algebra is the universal C*-algebra generated by the family of the resolvents of operators satisfying canonical commutation relations (CCR). On the resolvent CCR algebra, we considered one-parameter groups of $*$-automorphisms and their KMS states, which corresponds to the equilibrium states of weakly coupled anharmonic oscillators on $\mathbb{Z}$. We obtained the existence and the uniqueness of regular KMS states. This is joint work with Taku Matsui.

21 Kei Hasegawa (Kyushu Univ.) Bass–Serre trees of amalgamated free product C*-algebras 15

Summary: For any reduced amalgamated free product C*-algebra we will introduce a canonical larger C*-algebra of it, which is a natural analogue of the reduced crossed product of the compactification of the Bass–Serre tree associated with an amalgamated free product group. We then identify our algebra with a Cuntz–Pimsner algebra in a very explicit way. This framework provides new proofs of several known results on approximation properties and KK-theory.

22 Toshihiko Masuda (Kyushu Univ.) Classification of Roberts actions of strongly amenable C*-tensor categories on the injective factor of type III_1 15

Summary: We classify modularly free Roberts actions of finitely generated, strongly amenable C*-tensor categories on the injective factor of type III_1. We also present some applications of our classification theorem. Our proof is based on Popa's classification of strongly amenable subfactors of type III_1.

23 Reiji Tomatsu (Hokkaido Univ.) Continuous crossed product decomposition of an ultraproduct von Neumann algebras 15

Summary: I will talk about continuous crossed product decomposition of an ultraproduct von Neumann algebras.

24 Takahiro Hasebe (Hokkaido Univ.)
Marek Bozejko (Univ. of Wroclaw)
Wiktor Ejsmont (Wroclaw Univ. of Econ.) Fock space of type D 15

Summary: Bozejko and Speicher introduced deformations of the full Fock space by finite Coxeter groups. This talk focuses on the case when we take Coxeter groups of type D.

14:15–16:15

25 Yasumichi Matsuzawa (Shinshu Univ.) [b]
Hiroshi Ando (Chiba Univ.) Groups of unitaries without property (FH) 15

Summary: We show that some groups of unitaries do not have property (FH).

26 Hiroshi Ando (Chiba Univ.)
Yasumichi Matsuzawa (Shinshu Univ.)
Andreas Thom (TU Dresden)
Asger Törnquist (Univ. Copenhagen) Unitarizability, Maurey–Nikishin factorization and Polish groups of finite type 15

Summary: Let Γ be a countable discrete group, and $\pi\colon \Gamma \to \mathrm{GL}(H)$ be a representation of Γ by invertible operators on a separable Hilbert space H. We show that the semidirect product group $G = H \rtimes_\pi \Gamma$ is SIN (G admits a two-sided invariant metric compatible with its topology) and unitarily representable (G embeds into the unitary group $\mathcal{U}(\ell^2(\mathbb{N}))$), if and only if π is uniformly bounded, and that π is unitarizable if and only if G is of finite type: that is, G embeds into the unitary group of a II_1-factor. Consequently, we show that a unitarily representable Polish SIN group need not be of finite type, answering a question of Sorin Popa.

Summary: It is well known that hypergroups are obtained associated with symmetric random walks on regular polygons and regular polyhedrons. We discuss a relationship between finite hypergroups and finite graphs.

Summary: We show that, if a Hessian domain admits a global potential and a semi-simple Lie group with finite connected component acts on the domain as automorphisms, then there exists an invariant potential under the group action on the domain. This result follows from a fixed-point theorem for affine actions of the semi-simple Lie group.

Summary: For a non-compact real simple Lie group $G = KAN$, Wallach introduced the notion of *small* K-types. We study some kind of eigenfunctions in the space of matrix-valued spherical functions on G associated to a small K-type. In many cases, the restriction of such an eigenfunction to A turns out to be a solution of a simple modification of a hypergeometric system of Heckman and Opdam, and therefore be written using their hypergeometric function.

Summary: This is joint work with Toshiyuki Kobayashi aimed to extend the results of his earlier paper with Birgit Speh studying properties of symmetry breaking operators of $O(n,1)$. Symmetry breaking operators (SBOs) are G'-intertwining operators between the degenerate principal series representations of $G := O(p+1,q+1)$ and its closed subgroup $G' := O(p,q+1)$ parametrized each by one complex parameter. Similarly to the original paper, one is able to classify the space of SBOs for every pair of parameters and to study their properties (residue formulae, functional equations, images) in quite a detail. I will list these results, briefly explain what difficulties one runs at when compared with the original $q = 0$ case and how these are resolved.

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

Yasufumi Hashimoto (Univ. of Ryukyus) Distributions of multiplicities in length spectra for congruence subgroups

Summary: The length spectrum is a set of length of prime geodesics of a Riemann surface with finite volume. It is known that the length spectra of two Riemann surfaces are same if and only if the spectra of the Laplace–Bertrami operators on the corresponding Riemann surfaces are same. In this sense, the length spectrum is important to characterize the Riemann surfaces. The aim of this talk is to study the growth of the multiplicities in length spectra on the Riemann surfaces derived from congruence subgroups of the modular group. It is konwn that the multiplicities are unbounded for any volume finite Riemann surface. For the modular surface, its congruence subgroup $\Gamma_0(n)$ and the quaternion-type co-compact arithmetic groups, asymptotic formulas for square sums of the multiplicities were given by Bogomolny–Leyvraz–Schmit (1996), and Peter (2002) and Lukianov (2007). In this talk, we extend these asymptotic formulas to the higher level correlations of the multiplicities in the length spectra for any congruence subgroup of the modular group.

Statistics and Probability

March 24th (Fri) Conference Room VI

9:45–12:00

1 Yong Moo Chung (Hiroshima Univ.)
Hiroki Takahasi (Keio Univ.)
Juan Rivera-Letelier (Univ. Rochester)
Quadratic maps with flat rate function ····· 15

Summary: We have already announced that every non-renormalizable quadratic map satisfies the large deviation principle. In a typical case the large deviations rate function vanishes precisely at the physical measure. On the other hand, the number of quadratic maps with flat rate function is uncountable.

2 Isamu Dôku (Saitama Univ.)
On the compact support of superprocess determined by a random measure ····· 15

Summary: We consider the support problem for a class of superprocesses determined by a random measure, and discuss the sufficient condition for those superprocesses to have compact support.

3 Shigeyoshi Ogawa (Ritsumeikan Univ.)
Hideaki Uemura (Aichi Univ. of Edu.)
On strong inversion formulas of the natural SFT ····· 10

Summary: We are to present some basic properties of a special SFT (stochastic Fourier transform) called the natural SFT. In particular, we will show direct inversion formulas for the natural SFTs of Ito type and of Noncausal type.

4 Atsushi Takeuchi (Osaka City Univ.)
Malliavin calculus for marked Hawkes processes ····· 15

Summary: Consider a marked Hawkes process and its conditional intensity. The main purpose in this talk is to construct the integration by parts formula on them, and to apply it to the studies on the existence of the smooth densities with respect to the Lebesgue measure, from the viewpoint of the Malliavin calculus for jump processes.

5 Yuki Suzuki (Keio Univ.)
A diffusion process with a contracted Brownian potential ····· 15

Summary: A one-dimensional diffusion process with a contracted Brownian potential is studied. The minimum process and the maximum process of the process are also investigated.

6 Dai Taguchi (Ritsumeikan Univ.)
Libo Li (Univ. of New South Wales)
On the Euler–Poisson scheme for SDEs with positive jumps and Hölder continuous coefficient ····· 10

Summary: In this talk, we consider the strong rate of convergence for the Euler–Poisson scheme for stochastic differential equations with positive jumps and Hölder continuous coefficient.

Summary: We consider minimizing the probability of falling below a given target growth rate of certain functionals including control parameters on a finite time horizon T, and then look at its exponential decay rate as T goes to infinity. Establishing the duality relationship between this asymptotics and a certain risk-sensitive control problem over large time, and discussing about the "effective domain" of the rate function of the large deviation probability are considered the problems concerning large deviation control. We present some results about these problems, which are motivated by downside risk minimization for the growth rate of the wealth process in comparison with the preset benchmark process, appearing in mathematical finance.

Summary: We consider large deviation control for certain quadratic semi-martingale functionals under model uncertainty. Formulating a penalized version of the problem which discusses asymptotic behavior of the minimizing probability of falling below a given target growth rate of the controlled functionals, we address the duality relationship between this penalized problem and a certain risk-sensitive control problem under model uncertainty. We also discuss about the "effective domain" of the rate function of the large deviation probability concerned.

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

Tomoyuki Ichiba (Univ. of California, Santa Barbara) Stochastic analysis for collision of Brownian particles

Summary: In this talk we discuss colliding behaviors of Brownian particles which diffuse on the real line determined by a class of stochastic differential equations. Absence and presence of triple (or higher order) collisions among the particles are crucial in analysis of local time processes accumulated by these collisions. Especially, this analysis sheds light on some important characteristics (e.g., identification, strong/weak solution, time-reversal, invariant distributions) of both finite and infinite dimensional stochastic system with piece-wise constant coefficients. We also discuss perturbations of such system of stochastic differential equations.

15:30–16:30 Award Lecture for the 2016 MSJ Analysis Prize

Tomohiro Sasamoto (Tokyo Tech) The KPZ equation and integrable stochastic interacting systems

Summary: The Kardar–Parisi–Zhang (KPZ) equation is a nonlinear partial differential equation, introduced in 1986 to describe surface growth phenomena. In 2010, a compact formula for the distribution of the surface height was obtained, and it was shown that the limiting distribution is non-Gaussian associated with the characteristic fluctuation exponent 1/3. Since then there have been vast progress on the understanding of this equation. The meaning of the solution of this equation has been made clearer, notably by the theory of regularity structures by M. Hairer. Moreover the solvability of the KPZ equation has led to the discovery of a family of integrable stochastic interacting systems related to random matrix theory, Macdonald polynomials, and quantum integrable systems. In this presentation we explain these developments.

March 25th (Sat) Conference Room VI

9:50–11:30

9 Masayuki Horiguchi (Kanagawa Univ.) On a multivariate Bayesian control problem in Markov decision processes 15

Summary: In this talk, we consider a multivariate Bayesian control chart model, which is formulated as Markov Decision Process (MDP). The objective is to minimize the total discounted cost before stopping the system in order to inspect whether the system is in-control or out-of-control. By applying λ-maximization technique and Dynamic programming approach, we have a discounted optimal policy of control limit type.

10 Noboru Nomura (Kochi Univ.) Evaluation procedure of orthant probabilities with conditional distribution in subspaces 10

Summary: A procedure which evaluates probability that multivariate normal distribution falls in an orthant is considered. In the procedure, the problem of evaluation of an orthant probability is converted to a problem that a vector with independently distributed elements falls in a convex conical hull. The converted problem is evaluated by splitting the hull and resolving the problems to lower dimensional one by numerical integration. The number of hulls generated by splitting the p-dimensional hull is p, at most. The resolved problems can be represented using projections of original problems to subspaces, and intermediate problems are shared by higher dimensional problems. Therefore, the amount of computation is reduced.

11 Hayato Takahashi Recent progress on random sequences with respect to conditional probabilities 15

Summary: The notion of conditional probability is one of the central idea in probability theory and statistics. Kolmogorov succeeded to formalize the mathematical notion of conditional probability by introducing measure theory in probability theory. The notion of randomness is a substantial subject as well and he gave a satisfactory definition of randomness with the help of mathematical logic. However no one succeeded to give a satisfactory definition to conditional probabilities. The author succeeded to give a definition with respect to conditional probabilities, and I would like to talk about recent progress in this area.

12 Yujie Xue (Waseda Univ.)
Taniguchi Masanobu (Waseda Univ.) Local Whittle likelihood approach for L^p-norm spectra 10

Summary: To estimate the spectral density, there are many approaches. For Gaussian stationary processes, Taniguchi (1979) has defined two divergences in fitting a certain parametric family of spectral densities $\{f_\theta(\lambda); \theta \in \Theta\}$ to a Gaussian stationary process with true spectral density $g(\lambda)$. In this paper, we introduce a local Whittle likelihood of the spectral density $f_\theta(\lambda)$ for the form of $|1-\phi_\theta(\lambda)|^{-p}$. It is shown that the asymptotic variance of $|1-\phi_{\hat{\theta}_h}(\lambda)|^{-p}$ which minimizes the local Whittle likelihood around λ, is $O(\frac{1}{Nh})$, where $h \to 0$, and $Nh \to \infty$ as $N \to \infty$. It is the same order as the smoothed periodogram estimator, but for fixed h, the former potentially has a smaller bias.

13 Fumiya Akashi (Waseda Univ.)
Jianqing Fan (Princeton Univ.)
Self-normalized and random weighting approach to likelihood ratio test for the model diagnostics of stable processes 15

Summary: In this talk, we construct the robust likelihood ratio test based on the self-normalized periodograms for infinite variance time series models. For heavy-tailed time series models, it is often difficult to represent the likelihood ratio statistic explicitly. So in this talk, we construct the Whittle likelihood ratio-based test statistic, and approximate the distribution of the statistics by the frequency domain bootstrap method. The result is shown to be applicable to various important problems involving model diagnostics. We also check the finite sample performance of the method via some simulation results, and observe that the proposed method works well for both Gaussian and heavy-tailed models. That is, the robust properties of the method is elucidated.

14 Fumiya Akashi (Waseda Univ.)
Shuyang Bai (Univ. of Georgia)
Murad S. Taqqu (Boston Univ.)
Quantile regression-based self-normalized block sampling method for linear regression model with dependent errors 15

Summary: This talk considers an estimation problem for a coefficient of linear regression models. In particular, the model concerned possibly has infinite variance or long-range dependence. When the model has heavy-tails or long-range dependence, the rate of convergence of fundamental statistics involves the unknown index of the models, and the limit distribution has an intractable form. To overcome these problems, we make use of the self-normalized block sampling method, and approximate the limit distribution directly. The consistency of the proposed method is shown. Based on the results, the robust estimation procedure for heavy-tailed and long-memory process is established. We also report results of simulation experiments, and the proposed method works well in practical situations.

15 Katusi Fukuyama (Kobe Univ.)
Shinji Sakaguchi (Aioi Nissay Dowa Insurance)
Osamu Shimabe (Hamada Electrical Industries)
Martina Tscheckl (Kobe Univ.)
Metric discrepancy results for geometric progressions with ratios 3/2, 4/3, 8/3, 10/3, 13/6 and 17/8 5

Summary: We presents constants in the law of the iterated logarithm for geometric progressions with ratios 3/2, 4/3, 8/3, 10/3, 13/6 and 17/8.

11:30–12:00 Research Section Assembly

13:30–14:30

16 Yan Liu (Waseda Univ.)
Kun Chen (Southwestern Univ. of Finance and Economics)
Ngai Hang Chan (Chinese Univ. of Hong Kong)
Masanobu Taniguchi (Waseda Univ.)
A frequency domain bootstrap for irregularly spaced spatial data ···· 15

Summary: In this talk, we consider the problem of bootstrapping irregularly spaced spatial data. Although there are many methods to bootstrap dependent data, we adopt a frequency domain bootstrap from computational time and its scope of application. The frequency domain bootstrap is a methodology to bootstrap periodogram based on Studentized periodogram ordinates. We take a specific increasing set of discrete frequencies for the bootstrap since the domain of the finite Fourier transform is not bounded for irregularly spaced data. We show that the frequency domain bootstrap is second-order correct for classes of ratio statistics under mixed increasing domain. The performance of the frequency domain bootstrap is shown in our simulation study. The method is also applied to some real examples.

17 Yurie Tamura (Waseda Univ.)
Masanobu Taniguchi (Waseda Univ.)
Asymptotic theory of sphericity test statistic for high-dimensional time series ····· 10

Summary: Recently, several studies on sphericity test statistic U for multivariate data have been proposed under the condition that the dimension p of observation is comparable with the sample size n. Ledoit and Wolf (2002) proved its asymptotic normality and consistency in i.i.d. case, as n and p tend to infinity at the same rate, i.e., $p/n \to c \in (0, \infty)$. In this talk, under the same condition, the asymptotics of U are elucidated when the observations are generated from multivariate Gaussian stationary processes. Then, it is shown that an appropriately standardized version of U is asymptotically normal even in the case of high-dimensional time series. Some interesting numerical examples are provided.

18 Yoshiyuki Tanida (Waseda Univ.)
Masanobu Taniguchi (Waseda Univ.)
Asymptotic theory of Whittle estimator for high dimensional time series ····· 10

Summary: Recently, in many fields, e.g., electrical and genome engineering, high-dimensional and small sample size data are often observed, and the various methods have been investigated to deal with such data appropriately. Most of classical results discussed estimation of the autocovariance matrices for non-Gaussian dependence processes. However, in time series analysis, the sample autocovariance matrices are only special case of the integral functional of spectral density matrix. In this paper, we develop the estimation theory for Whittle functional $\boldsymbol{D}$ of high-dimensional non-Gaussian dependent processes. Using a sample version of $\boldsymbol{D}$ based on thresholded periodogram matrix, we introduce a Whittle estimator of unknown parameter, and elucidate its asymptotics. Some numerical studies illuminate an interesting feature of the results.

19 Kazuyoshi Yata (Univ. of Tsukuba) Consistency for high-dimensional eigenvectors ····· 15
Makoto Aoshima (Univ. of Tsukuba)

Summary: In this talk, we consider estimation of eigenvectors in high-dimensional settings. First, we show that the sample eigenvector is not a consistent estimator of the true eigenvector in terms of the Euclid norm for high-dimensional settings. Yata and Aoshima (2012, JMVA) proposed a new PCA method called the noise reduction (NR) methodology. The estimation of the eigenvector by the NR method has a consistency property in terms of an inner product. However, it does not hold a consistency property in terms of the Euclid norm. With the help of a threshold method, we modify the eigenvector by the NR method. We propose a new eigenvector estimation. We show that it holds the consistency property of the Euclid norm.

March 26th (Sun) Conference Room VI

9:50–12:00

20 Shuhei Mano (Inst. of Stat. Math.) Multiplicative measure on partitions and the A-hypergeometric system associated with the rational normal curve ····· 15

Summary: Exchangeable combinatorial structures appear in various statistical contexts, such as nonparametrics and sampling theory. A general model is known as the multiplicative measure, and the conditional model is an algebraic exponential family, whose normalization constant is the A-hypergeometric polynomial associated with the rational normal curve. The maximum likelihood estimatior (MLE) of the full and the curved exponential families are studied in terms of the information geometry of the Newton polytope. It is shown that the MLE does not exist for the full exponential family.

21 Tomonari Sei (Univ. of Tokyo) Stein-type identity derived from coordinate-wise transformations ····· 15

Summary: It is shown that for a given multi-dimensional probability distribution with some regularity conditions there exists the unique coordinate-wise transformation such that the transformed measure satisfies a Stein-type identity. The proof is based on an energy minimization problem over a subset of the Wasserstein space. The result is interpreted as a generalization of the diagonal scaling theorem established by Marshall and Olkin (1968).

22 Tamio Koyama (Shiga Univ.) An integral formula for the powered sum of the independent, identically and normally distributed random variables ····· 15

Summary: We give an integral formula for the probability density function of the powered sum of independent, identically distributed random variables with the standard normal distribution. Our formula is written by the characteristic function of the power of the standard normal variable and one-dimensional complex integration. In order to derive this formula, we utilize the theory of Fourier hyperfunctions introduced by Mikio Sato.

Summary: We discuss a new kernel type estimator for nonnegatively supported density function $f_X(x)$, using pdf of gamma distribution. Chen (2000, Ann. Inst. Stat. Math.) introduced two gamma kernels which are $Gamma\left(\frac{x}{h}+1, h\right)$ and $Gamma(\rho_h(x), h)$ densities. The order of convergence of variances are $O\left(\frac{1}{n\sqrt{h}}\right)$ in the interior and $O(\frac{1}{nh})$ near boundary. Under some conditions for x and h, Chen showed his estimators having $O(n^{-\frac{4}{5}})$ for the optimal mean squared error.

Summary: For square contingency tables with ordered categories, this presentation proposes a generalized diagonal exponent conditional symmetry model which indicates that in addition to the structure of conditional symmetry of the probabilities with respect to the main diagonal of the table, the log-ratio of adjacent two probabilities along subdiagonal of the table is the sum of polynomial of row value and polynomial of column value with same coefficients. Also this presentation gives the decomposition using proposed model.

Summary: For the analysis of square contingency tables, Iki, Tahata, and Tomizawa (2012) considered a measure to represent the degree of departure from marginal homogeneity. However, the maximum value of this measure cannot distinguish two kinds of marginal inhomogeneity. This presentation proposes a measure which can distinguish two kinds of marginal inhomogeneity for square tables with ordered categories. Especially the proposed measure is useful for representing the degree of departure from marginal homogeneity when the marginal cumulative logistic model holds.

Summary: For the analysis of square contingency tables, Tomizawa, Seo and Yamamoto (1998) and Tomizawa, Miyamoto and Hatanaka (2001) considered measures that represent the degree of departure from symmetry. This presentation proposes a measure that represents the degree of asymmetry for square contingency tables with ordered categories using cumulative probabilities. The measure proposed is expressed using the Cressie–Read power-divergence or Patil–Taillie diversity index, defined for the cumulative probabilities that an observation falls in row (column) category i or below and column (row) category j or above. It should be useful for comparing the degree of asymmetry in several tables with ordered categories.

27 Tomohisa Maruyama (Tokyo Univ. of Sci.)
Yusuke Saigusa (Tokyo Univ. of Sci.)
Kouji Tahata (Tokyo Univ. of Sci.)
Sadao Tomizawa (Tokyo Univ. of Sci.)

Decomposition of marginal homogeneity using model based on complementary log-log transform for square contingency tables 10

Summary: For square contingency tables with ordered categories, McCullagh (1977) considered the model using the logit transform, which is an extension of the marginal homogeneity model. We shall propose the model using the complementary log-log transform. Also we shall give the decomposition of the marginal homogeneity model using the proposed model.

28 Yutaro Kubo (Tokyo Univ. of Sci.)
Yusuke Saigusa (Tokyo Univ. of Sci.)
Koji Tahata (Tokyo Univ. of Sci.)
Sadao Tomizawa (Tokyo Univ. of Sci.)

A measure of departure from partial marginal homogeneity for square contingency tables 10

Summary: For square contingency tables, Tomizawa and Makii (2001) considered the measure of departure from marginal homogeneity model given by Stuart (1955). We consider the partial marginal homogeneity model which indicates that there is a homogeneous structure for at least one of pairs of row and column marginal probabilities. We also propose the measure to represent the degree of departure from the partial marginal homogeneity model.

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

Gaku Igarashi (Univ. of Tsukuba) Boundary-bias-free asymmetric kernel density estimators

Summary: The kernel density estimator is a popular nonparametric density estimator. The asymptotic properties of the kernel density estimator are well known. Also, some techniques that improve the convergence rate of the mean integrated squared error of the kernel density estimator were discussed. If the support of the underlying density is a closed interval or semi-infinite interval, then the bias of the kernel density estimator is $O(1)$ near the boundary. Such a boundary bias problem is caused by the kernel that creates a mass outside the support of the underlying density. In order to avoid such a boundary bias problem, some remedies, renormalization, reflection, and so on, were discussed in the literature. In the recent fifteen years, several asymmetric kernel (AK) estimators of a density with support $[0, \infty)$ or $[0, 1]$ have been suggested. The support of the AK matches the support of the underlying density. In this talk, problems of some existing AK density estimators are pointed out, and some AK density estimators avoiding the problems are shown. Also, its bias reductions are considered.

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

Yasunori Fujikoshi (Hiroshima Univ.*) High-dimensional properties of the estimation methods for reduced-dimensionality based on information criteria

Summary: In this talk we consider the estimation methods for reduced-dimensionality based on information criteria, in principal component analysis, multivariate regression model, discriminant analysis and canonical correlation analysis. Our main purposes are to study consistency properties of the estimation methods when both the sample size and the number of variables are large. Some results are given in Fujikoshi and Sakurai (2016, JMA), Bai, Fujikoshi and Choi (2016, Submitted), etc. In addition to the case when the sample size is larger than the number of variables, we consider also the case when the number of variables are larger than the sample size, assuming that the covariance structure is independent and uniform.

March 27th (Mon) Conference Room VI

9:50–12:00

Summary: We estimate mutual information (MI) from a pair of sequences, where the two variables X, Y may be either discrete or continuous. For discrete variables, we evaluate Bayesian marginal likelihoods of X, Y, and (X, Y), and construct an MI estimation. For continuous variables, we prepare several two-dimensional quantizations, and estimate the MI value for the discretized samples for each quantization. The final estimation is obtained by choosing the maximum value of those estimations. In this paper, we prove that the estimation is consistent in the sense that the MI estimation converges to the true value as the sample size grows even if each of X, Y is either discrete, continuous, or none of them.

Summary: We construct a log-Pareto-tailed skew normal distribution. Since the proposal distribution has super-heavy tailed, it works well for whole robust estimation of location and scale parameters. In simulation studies, we compare maximum likelihood estimators of location and scale parameters among some distributions in the presence of outliers.

Summary: The Ewens sampling formula describes the law of the allelic partition of the sample from the infinitely-many neutral allele population. For this law, we study asymptotics when both the mutation parameter θ and the sample size n are large. The first result is Poisson approximations for the number K_n of alleles when θ grows with n. The second result is a verification of the asymptotic independence of the component counts under some large θ settings.

Summary: The Dantzig selector for a special parametric model of diffusion processes is studied in this paper. In our model, the diffusion coefficient is given as the exponential of the linear combination of other processes which is regarded as covariates. We propose an estimation procedure which is an adaptation of the Dantzig selector for linear regression models and prove the l_q consistency of the estimator for all $q \in [1, \infty]$.

Summary: We consider a linear mixed model with two random coefficients. The usual AIC is not asymptotically unbiased as an estimator of the risk based on Kullback–Leibler divergenece when the covariance matrix of the random coefficient vector is close to zero matrix. Using Laplace's method, we derive the asymptotic bias of the usual AIC and consider to correct the bias.

Summary: We consider the third-order linear model based on a fractional factorial design with m factor each at three levels, which is derived from a simple array (SA), where $m \geq 6$. Then the non-negligible factorial effects are the general mean, the linear and the quadratic components of the main effect, the linear by linear and the linear by quadratic components of the two-factor-interaction, and the linear by linear by linear components of the three-factor interaction. Under this model, if all the main effects are estimable, and furthermore the remaining non-negligible factorial effects may or may not be estimable, then a design is said to be of resolution $\mathrm{R}^*(\{10, 01\})$. In this talk, we give a necessary and sufficient condition for an SA to be of resolution $\mathrm{R}^*(\{10, 01\})$, where the number of assemblies is less than the number of non-negligible factorial effects and $\#\{(x, y) \,|\, 1 \leq x, y \leq m-2,\ x+y \leq m-1\} \geq 1$.

Summary: A hierarchical 3-design, denoted by 3-HD$(v, u \times k, \lambda_3)$, is newly defined. This concept is closely connected with resolvable 3-designs, nested 3-designs, splitting-balanced block designs and authentication codes. The purpose of this talk is to discuss the property of a 3-HD$(v, u \times k, \lambda_3)$ and to provide the existence of a 3-HD$(uk, u \times k, \lambda_3)$ with $u = 2, 3, 4$ through other combinatorial designs.

Summary: Difference systems of sets (DSS) are combinatorial structures introduced by Levenshtein in 1971, which are a generalization of cyclic difference sets and arise in connection with code synchronization. A DSS is a collection of t disjoint subsets $Q_i, 0 \leq i \leq t-1$, of $\mathbf{Z}_n$ such that every element of $\mathbf{Z}_n \backslash \{0\}$ appears at least ρ times in the multiset $\{a - b \pmod n |\ a \in Q_i, b \in Q_j, 0 \leq i \neq j \leq t-1\}$. In this talk, we give some recursive constructions of DSSs by using DSSs forming partition of a difference set.

Applied Mathematics

March 24th (Fri) Conference Room V

10:30–11:45

1 Kazuhiko Ushio — Balanced C_{10}-foil designs and related designs ····· 15

Summary: In graph theory, the decomposition problem of graphs is a very important topic. Various type of decomposition of many graphs can be seen in the literature of graph theory. This paper gives balanced C_{10}-foil designs and related designs.

2 Diogo Kendy Matsumoto (Shibaura Inst. of Tech.) — Navigation groupoids and its application ····· 15

Summary: In this talk, we construct an algebraic system called a navigation groupoid by using rooted spanning trees on a graph. As an application, we talk about a relation between the navigation system and the travel groupoid.

3 Yutaro Sakamoto (Univ. of Electro-Comm.) — Hamilton cycles in double generalized Petersen graphs ····· 15

Summary: In graph theory, the existance of Hamilton cycles is one of basic properties of graphs and it has been researched for many years. In this talk, we introduce double generalized Petersen graphs (DGPGs) and construct Hamilton cycles in all DGPGs.

4 Kenta Noguchi (Tokyo Denki Univ.) — 2-cell embeddings of optimal 1-planar graphs ····· 15

Summary: In this talk, we show the following: For an orientable surface $\mathbb{S}_g$ of genus g, there exists an optimal 1-planar graph which quadrangulates $\mathbb{S}_g$ if and only if $g \geq 3$. For an non-orientable surface $\mathbb{N}_k$ of genus k, there exists an optimal 1-planar graph which quadrangulates $\mathbb{N}_k$ if and only if $k = 6$ or $k \geq 8$. Furthermore, every optimal 1-planar graph with $2g+2$ vertices quadrangulates $\mathbb{S}_g$, and every optimal 1-planar graph with $k+2$ vertices quadrangulates $\mathbb{N}_k$.

14:15–15:30

5 Rachel Bass (Georgia Southern Univ.), Colton Magnant (Georgia Southern Univ.), Kenta Ozeki (Nat. Inst. of Information / JST ERATO), Brian Pyron (Georgia Southern Univ.) — Characterization of edge-colorings of complete graphs with forbidden rainbow subgraphs ····· 10

Summary: In this work, we characterize all edge-colorings of complete graphs without rainbow $K_{1,3}$ and those without rainbow P_4^+, where P_4^+ is the graph consisting of P_4 with one extra edge incident with an inner vertex. We also apply these classifications to other areas like highly connected monochromatic subgraphs with large size, anti-Ramsey numbers, Gallai–Ramsey numbers and show some implications between forbidden rainbow subgraphs.

6 Shinya Fujita (Yokohama City Univ.) Partition problem on edge-colored graphs 10

Summary: We propose a partition problem on edge-colored graphs. Some new results on this problem will be reviewed.

7 Jun Fujisawa (Keio Univ.)
Robert E. L. Aldred (Univ. of Otago)
Akira Saito (Nihon Univ.)
Edge proximity conditions for matching extendability of graphs 15

Summary: A matching M of G is said to be extendable in G if M is a subset of a perfect matching of G, and a graph with at least $2m+2$ vertices is said to be distance d m-extendable if any matching M with $|M| = m$ in which the edges lie pair-wise distance at least d is extendable. In this talk we introduce the following results: 1) Every 5-connected plane graph of even order in which at most two faces are not triangular is distance 3 4-extendable; 2) Every connected, locally 2-connected claw-free graph of even order is distance 2 m-extendable for any m; 3) Every connected, locally 3-connected $K_{1,4}$-free graph of even order is distance 5 m-extendable for any m.

8 Chie Nara (Meiji Univ.)
Jin-ichi Itoh (Kumamoto Univ.)
Erik D. Demaine (MIT)
Martin L. Demaine (MIT)
Continuous flattening of orthogonal polyhedra 15

Summary: Can we flatten a polyhedral piece of paper without cutting and stretching? For any convex polyhedron, the first and second authors together with C. Vilcu gave such continuous flattening motion by using cut loci and the Alexandrov's gluing theorem in 2012, and in 2014 all four authors et al. showed another continuous flattening motion by using straight skeleton and orderly squashing. In this talk, we show that for any (semi-)orthogonal polyhedron there is a continuous flattening motion such that all faces orthogonal to z-axis have no creases during the motion, where a polyhedron in the xyz-space is called orthogonal polyhedron if any face is orthogonal to x, y, or z-axis.

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

Ying Miao (Univ. of Tsukuba)[♭] Combinatorics of Digital Fingerprinting

Summary: In order to protect copyrighted digital information, digital fingerprinting was introduced to trace the source of pirate copies, thereby discouraging attempts at collusion attacks for unauthorized redistribution of the information. Various fingerprinting schemes have been proposed since the late 1990s, such as codes with the identifiable parent property, frameproof codes, traceability schemes, and separable codes. In this talk, we survey some new progress made after Blackburn's survey paper in 2003, again emphasizing the underlying combinatorics involved. It can be seen that combinatorics (such as design theory, graph theory, finite geometry, extremal combinatorics, coding theory, and group testing) is essential in the investigation of fingerprinting schemes.

March 25th (Sat) Conference Room V

10:00–11:45

9 Tomoya Machide (Nat. Inst. of Information / JST ERATO) Symmetric sum of regularized multiple zeta values and set partition 15

Summary: In this talk, we introduce the identity involving symmetric sums of regularized multiple zeta values of shuffle type. In the proof, we encounter the cycle index polynomial for the symmetric group, that is discussed in the Stanley's book "Algebraic combinatorics. Walks, trees, tableaux, and more".

10 Hideo Mitsuhashi (Utsunomiya Univ.), Norio Konno (Yokohama Nat. Univ.), Iwao Sato (Oyama Nat. Coll. of Tech.) Quaternionic second weighted zeta functions of finite graphs 15

Summary: We establish a generalization of the second weighted zeta function of a graph to the case of quaternions. For an arc-weighted graph whose weights are quaternions, we define the second weighted zeta function by using the Study determinant that can be viewed as a determinant for quaternionic matrices. This definition is regarded as a quaternionic analogue of the determinant expression of Hashimoto type for the Ihara zeta function of a graph. We derive the Study determinant expression of Ihara type and the Euler product for the quaternionic second weighted zeta function.

11 Iwao Sato (Oyama Nat. Coll. of Tech.), Norio Konno (Yokohama Nat. Univ.), Etsuo Segawa (Tohoku Univ.) The spectra of the time evolution matrices of Szegedy walk and SQW 15

Summary: We present formulas for the characteristic polynomials of the time evolution matrices of the Szegedy walk on a bipartite graph and a 2-tessellable staggered quantum walk (SQW) on a graph, and so directly give their spectra.

12 Kei Saito (Yokohama Nat. Univ.) The quaternionic quantum walk on the one-dimensional lattice 15

Summary: The discrete-time quantum walk (QW) is determined by a unitary matrix whose component is complex number. Konno (2015) extended the QW to a walk whose component is quaternion. We call this model quaternionic quantum walk (QQW). The probability distribution of a class of QQWs is the same as that of the QW. On the other hand, a numerical simulation suggests that the probability distribution of a QQW is different from the QW. In this talk, we clarify the difference between the QQW and the QW by weak limit theorems for a class of QQWs.

13 Takashi Komatsu (Yokohama Nat. Univ.)
Hikari Kawai (Yokohama Nat. Univ.)
Norio Konno (Yokohama Nat. Univ.)
Seiya Yoshida (Yokohama Nat. Univ.)
Stationary measures of three-state quantum walks on the one-dimensional integer lattice 15

Summary: One of the basic interests is to determine stationary measures of quantum walks. In our previous work, we obtained stationary measures for the three-state Fourier walk on the one-dimensional integer lattice by solving the corresponding eigenvalue problem. This stationary measure is a non-trivial stationary measure with a periodicity. In this talk, we discuss stationary measure of a class of three-state quantum walks including the Fourier and Grover walks.

14 Akito Suzuki (Shinshu Univ.) Weak limit theorem for two-dimensional two-state quantum walks with position dependent coins 15

Summary: We address two-dimensional two-state quantum walks with position dependent coins. Assuming that coins satisfy a short range condition, we prove the weak limit theorem for this walk.

14:00–14:15 Presentation Ceremony for the 2016 MSJ Prize for Excellent Young Applied Mathematicians

March 26th (Sun) Conference Room V

9:30–12:00 Special Session "Modern trends on the theory of convex polytopes"

Satoshi Murai (Osaka Univ.) Recent developments on face numbers of convex polytopes 40

Summary: The study of the number of faces of convex polytopes is one of the central topics in algebraic, geometric and topological combinatorics. The origin of its research goes back to Euler's Polyhedron Theorem, which was found in the 18th century, but there still be a lot of open problems and new developments on this topic. In this talk, I will introduce some of recent developments on the study of face numbers of convex polytopes.

Akihiro Higashitani (Kyoto Sangyo Univ.) History and future of the theory of lattice polytopes 40

Summary: One of the origins of the theory of lattice polytopes is "Pick's formula". Pick's formula claims that the area of a polygon whose vertices are lattice points can be computed just by counting the number of lattice points contained in its interior and its boundary. As an analogy of Pick's formula, Ehrhart theory has appeared in 1960's. Eugèn Ehrhart proved that for a lattice polytope $P \subset \mathbb{R}^d$ of dimension d, the enumerative function $|nP \cap \mathbb{Z}^d|$ becomes a polynomial in n of degree d with its constant 1 and the leading coefficient of such polynomial coincides with the volume of P. We call this polynomial $|nP \cap \mathbb{Z}^d|$ the Ehrhart polynomial of P. In this talk, after reviewing Ehrhart theory, we will survey the recent topics of the study of lattice polytopes and their Ehrhart polynomials.

Takayuki Hibi (Osaka Univ.) Let's listen a trio of convex polytopes, commutative algebra and statistics 40

Summary: In statistics the Markov chain Monte Carlo method is a class of algorithms for sampling and is achieved by using a connected Markov chain. To construct a connected Markov chain, a Markov basis is required. It turned out that Markov bases can combine statistics with commutative algebra via toric ideals. The toric ideal is one of the most important keywords in the current trends of commutative algebra and has rapidly developed under the strong influence of Gröbner bases. On the other hand, the deep connection between commutative algebra and convex polytopes originated in the work of Richard Stanley on the upper bound conjecture for spheres in 1975 and, after the early 1990s, via toric ideals and Gröbner bases, commutative algebra provides a powerful tool to study triangulations of convex polytopes.
In my talk, based on the joint work [S. Aoki, T. Hibi and H. Ohsugi, Markov chain Monte Carlo methods for the Box–Behnken designs and centrally symmetric configurations, *Journal of Statistical Theory and Practice* **10** (2016), 59–72], which studies statistical models for count data arising in Box–Behnken designs together with toric ideals of convex polytopes arising from root system $\mathbf{D}_n$, a fascinating trio of convex polytopes, commutative algebra and statistics will be played.

14:15–16:30

15 Masayuki Akamatsu (Japan Coast Guard Academy) Dual problem for bivariate function by perturbarion function 15

Summary: We formulate dual problems for bivariate function using perturbation function. Partial conjugate of perturbation function defines partial dual problem as a saddle problem and its full conjugate defines full dual problem. The full dual problem is the same as dual problem for univariate function defined by Rockafellar. We give duality theorems between primal and partial dual problems and between partial dual and full dual problems. These duality theorems are extensions of those for univariate function given by Rockafellar.

16 Shunzi Horiguchi (Niigata Sangyo Univ.) Extended complex Newton's method and Riemann surface, various formulas to compare convergences 10

Summary: We extend the complex Newton's method. We give a relation between the Riemann surface and extended complex Newton's method, and various formulas to compare convergences of extended complex Newton's methods.

17 Fuminori Sakaguchi (Univ. of Fukui) On the hyperfunction components of extra solutions in an integer-type algorithm for ODEs 15

Summary: An integer-type algorithm for solving ODEs was proposed by the author and M. Hayashi. This algorithm is based on the expansion of solution functions by rational-function-type basis functions, and it is based on the 'exact' kernel vectors of non-square matrices. In this algorithm, we can read and 'decipher' integer coefficient sequences directly, and hence we can analyze behavior of numerical solutions exactly and pure-mathematically. In this study, the author gives several numerical examples where it is clearly shown that many hyperfunction components are contained in extra solutions mixed in numerical solutions obtained by this algorithm, by a direct 'decipherment' of integer coefficient sequences contained in numerical results by this algorithm.

Summary: On shape optimization of singular points, the finite element analysis by generalized J-integral has been established and the numerical results are obtained. We examine a method to predict why such numerical results are provided mathematically. I talk progress about this examination on the way.

Summary: Let X be an infinite-dimensional Hilbert space and let A be a compact operator on X. We proved that if 1 is included in the resolvent set of A then $\|(I-A)^{-1}\| \geq 1$ is satisfied. Moreover, we would report that a similar result for some approximate operator of $(I-A)^{-1}$ consists.

Summary: Discontinuous Galerkin (DG) method is one of numerical methods for solving partial differential equations. In DG methods, the solution is approximated by discontinuous piecewise polynomials, and its continuity between each element is controlled by numerical flux. The analysis of the DG methods in L^2 and energy norms were well developed so far. However it seems that there are only a few works using other norms. In this paper, we show L^∞ estimates and offer some numerical result for Poisson equation on polygonal domain. We do not pose the convexity of the shape of a domain.

Summary: We consider surface area approximations by Lagrange and Crouzeix–Raviart interpolations on triangulations. For Lagrange interpolation, we give an alternative proof for Young's classical result that claims the areas of inscribed polygonal surfaces converge to the area of the original surface under the maximum angle condition on the triangulation. For Crouzeix–Raviart interpolation we show that the approximated surface areas converge to the area of the original surface without any geometric conditions on the triangulation.

Summary: It is well-known that the central difference approximation and the Galerkin finite element approximation to the convection term lead to the instability. Much effort has been done to develop stable schemes during the last four decades. The upwind-element choice approximation is one of the upwind finite element approximations developed in the earliest days. The approximation has been applied successfully to the numerical computation of the flow problems such as the convection-diffusion problems and the Navier–Stokes problems. Although the convergence proof for the convection-diffusion had been done when the approximation was developed, the proof for the Navier–Stokes problems has not been done. Here we give the proof of the convergence for the Navier–Stokes equation.

16:50–17:50 Talk Invited by Applied Mathematics Section

Norbert Pozar (Kanazawa Univ.) A level set approach to the crystalline mean curvature flow

Summary: In this talk I will present some recent results concerning the analysis of the level set formulation of the crystalline mean curvature flow as well as an efficient numerical method. Real crystals typically develop facets, flat parts of the surface, that are preserved in the growth. One way to understand this phenomenon is to model the crystal growth as a gradient flow of a surface energy of the crystal, with the surface energy density being a convex piece-wise linear function of the normal direction. This leads to the notion of the so-called crystalline mean curvature flow $V = f(\nu, \kappa_\sigma)$, proposed independently by Angenent, Gurtin (1989) and Taylor (1991), where the normal velocity V of the crystal surface is proportional to the normal vector ν and the crystalline mean curvature κ_σ with surface energy density given by a crystalline anisotropy σ. If the motion of the crystal surface is then tracked by the level set method, the level set function is a solution of a very singular partial differential equation of a parabolic type. In a joint work with Yoshikazu Giga (U. of Tokyo), we have succeeded in establishing the well-posedness of this problem in the class of viscosity solutions for compact crystals in an arbitrary dimension, as well as a comparison principle and stability with respect to approximation by a smooth anisotropic curvature flow. Furthermore, I will discuss a numerical approach to this problem via the minimizing movements algorithm due to Chambolle (2004), improved later using the split Bregman algorithm by Oberman, Osher, Takei, Tsai (2011). I will also show some numerical results for illustration.

March 27th (Mon) Conference Room V

9:30–11:30

23 Toshikazu Kuniya (Kobe Univ.)
Jinliang Wang (Heilongjiang Univ.)
Ran Zhang (Harbin Inst. of Tech.)
Mathematical analysis of an HIV model with infection-age-structure and nonlinear incidence ····· 15

Summary: In this study, we are concerned with an HIV model with infection-age-structure and nonlinear incidence, which is formulated as a system of partial differential equations. We define the basic reproduction number R_0 and investigate the relation between it and the global asymptotic stability of each equilibrium. More precisely, we show the relative compactness of the orbit, the global asymptotic stability of the disease-free equilibrium when $R_0 \leq 1$, the uniform persistence of the system when $R_0 > 1$ and the global asymptotic stability of the endemic equilibrium when $R_0 > 1$. For the proof, we construct suitable Lyapunov functions. This study is collaborated with Drs. Jinliang Wang and Ran Zhang in Heilongjiang University.

24 Tetsuya Ishiwata (Shibaura Inst. of Tech.)
Emiko Ishiwata (Tokyo Univ. of Sci.)
Yukihiko Nakata (Shimane Univ.)
Katsuhiro Miki
Delay-induced blow-up in a limit-cycle osciillation model ····· 15

Summary: We consider a blow-up of solutions to some delay differential equation, which non-delayed version never have blow-up solutions. We show that the problem has blow-up solutions for any positive time delay. We also show some numerical simulations and discuss the behaviour of solutions.

25 Kaname Matsue (Kyushu Univ./Kyushu Univ.) — Quasi-Poincaré compactifications and blow-up solutions · · · · · · · · · · · · · 15

Summary: We construct a generalized compactification of Euclidean spaces as well as dynamical systems on them for studying blow-up solutions of ordinary differential equations. We apply the quasi-homogeneous desingularization to infinity so that divergent solutions including grow-up and blow-up solutions for differential equations whose asymptotic form is not necessarily homogeneous can be treated on compact spaces. As a prototype, we define the quasi-homogeneous version of Poincaré compactifications and discuss fundamental properties which play important roles to study blow-up solutions of inhomogeneous vector fields.

26 Kaname Matsue (Kyushu Univ./Kyushu Univ.) — Compactifications, blow-up solutions and singular shock waves · · · · · · · 15

Summary: As an application of quasi-Poincaré compactifications, we consider singular shock waves for systems of conservation laws in terms of several pieces of blow-up solutions and bounded solutions near infinity. We see that the quasi-Poincaré compactification well describes singular profiles of singular shocks observed in preceding studies.

27 Takuya Tsuchiya (Waseda Univ.), Gen Yoneda (Waseda Univ.) — Constructing of constraint preserving scheme for Einstein equations · · 15

Summary: We propose a new numerical scheme of evolution for the Einstein equations using the discrete variational derivative method (DVDM). We derive the discrete evolution equation of the constraint using this scheme and show the constraint preserves in the discrete level. In addition, to conform the numerical stability using this scheme, we perform some numerical simulations by discretized equations with the Crank–Nicolson scheme and with the new scheme, and we find that the new discretized equations have better stability than that of the Crank–Nicolson scheme.

28 Ryosuke Urakawa (Waseda Univ.), Takuya Tsuchiya (Waseda Univ.), Gen Yoneda (Waseda Univ.) — Analyzing constraint propagation of Einstein equation on non-flat background · 15

Summary: We propose a method of analyzing constraint propagation on a non-flat background in the ADM and the BSSN formulation by adding constraint terms to the evolution equation. In past studies, the eigenvalues of the constraint propagation were mostly obtained on the Minkowski background. Since they depend on backgrounds, we should calculate them on the background of each simulation. However calculating eigenvalues on a non-flat background is difficult, we calculate them numerically. We also perform numerical simulations to show the consistency between the eigenvalues and the numerical stability.

29 Hideki Murakawa (Kyushu Univ.) — A linear method for nonlinear diffusion problems · · · · · · · · · · · · · · · · · · 15

Summary: This talk deals with nonlinear diffusion problems including degenerate parabolic problems, such as the Stefan problems and the porous medium equations, and cross-diffusion systems, such as the Shigesada–Kawasaki–Teramoto model in population ecology. We propose a linear numerical method for the nonlinear diffusion problems. The method is a very easy-to-implement, stable and efficient scheme.

14:15–16:20

Summary: Here, we consider empirical construction of cellular automata (CA). Empirical CA construction is a statistical method to determine a rule of CA by using a given dataset, and this method can be applied to any spatio-temporal datasets in principle. The methodology of constructing the rule was showed by Kawaharada and Iima [1], however it has yet to be developed as a fully convincing method to capture a tendency of space-time patterns of the dataset. In this study, we focus on the viscous Burgers equation and take appropriate spatio-temporal scale to subsample the dataset for more effective empirical CA construction. We obtained good agreements between results of the resultant CA simulation and the original behaviours of the Burgers equation.

Summary: In vortex dynamics on surfaces, the geometric structure makes a huge difference in the vortex motion. We introduce vortex dynamics on toroidal surface, which is one of simplest nontrivial examples of surfaces having non-zero fundamental group and non-constant curvature. As a result, we find some characteristic interactions between point vortices on the torus.

Summary: The evolution of the vortex sheet is described by the nonlinear singular integrodifferential equation called the Birkhoff–Rott equation. However, the inital data problem of the Birkhoff–Rott equation seems to be ill-posed due to the Kelvin–Helmholtz instability. This is the reason why it is difficult to compute the motion of vortex sheets. The vortex blob method has been proposed to deal with this difficuity. We computed the evolution of two vortex sheet with the vortex blob method and could produce some pattern formations of vorticity, which can be observed in the real fluid. We also applied the vortex sheet model to compute the wake behind an oscillating plate.

Summary: We consider a periodic traveling wave and its bifurcation for a variant of the Benney equation that has a cubic rather than quadratic nonlinearity. The equation was derived by Komatsu and Sasa from the well-known Optimal Velocity model for traffic jam by the long-wave length approximation and asymptotic expansion. It admits a periodic traveling wave of kink-antikink type. As the spatial period increases, it undergoes a bifurcation leading to the emergence of a rippling rectangular wave, that is, the solution travels to the left-hand side while ripples on it also travel at a constant speed. We can regard this solution as a quasi-periodic solution. We study its property by applying a numerical continuation method for a invariant torus.

34 Ayuki Sekisaka (Meiji Univ.) Accumulation of eigenvalues for periodic boundary conditions ····· 15

Summary: Traveling waves or nonlinear waves important object in many applications in physics, engineering and in other areas of science. these are affected by noise externally or internal fluctuations. Therefore the stability problem is fundamental for the observation of phenomena in nature. One of the methods for the stability of traveling wave is to study the linearized operator associated with traveling waves. Under the periodic boundary condition, we show interesting phenomena which eigenvalues of such operator accumulate on the certain curve on the complex plane when the domain size tends to infinity.

35 Sungrim Seirin Lee (Hiroshima Univ.) Pattern formation on asymmetric cell division and mathematical problems ····· 15

Summary: Anterior-posterior (AP) polarity formation of cell membrane proteins plays a crucial role in determining cell asymmetry. In Caenorhabditis elegans, a single fertilized egg cell (P0), its daughter cell (P1), and the germline precursors (P2 and P3 cells) form two exclusive domains of different PAR proteins on the membrane along the anterior-posterior axis. However, the phenomenon of polarity reversal has been observed in which the axis of asymmetric cell division of the P2 and P3 cells is formed in an opposite manner to that of the P0 and P1 cells. The extracellular signal MES-1/SRC-1 has been shown to induce polarity reversal, but the detailed mechanism remains elusive. Here, using a mathematical model, I explore the essential mechanism underlying polarity reversal, providing a mathematical basis for the orientation of cell polarity patterns.

36 Syunsuke Kobayashi (Meiji Univ.)
Takashi Sakamoto (Meiji Univ.) Oscillatory hexagonal pattern in a 2-dimensional integro-differential reaction-diffusion system ····· 15

Summary: A 2-component integro-differential reaction-diffusion system in a rectangular domain is studied by local bifurcation theory. Studying the bifurcation around the trivial solution, we find that the stationary hexagonal solution bifurcates from the trivial solution. Further we find that a oscillatory hexagonal solution bifurcates from the stationary hexagonal solution through Hopf bifurcation. Finally this oscillatory hexagonal solution appears stably.

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

Shigetoshi Yazaki (Meiji Univ.) How to track the moving boundary arising in interfacial phenomena

Summary: Interfacial phenomena can be observed in various kinds of physical phenomena and have been attracted and studied in many years by mathematicians and physicians. The interface is boundary between two different phases and if the interface is sharp, then it can be regarded as a plane curve or a surface in the space. In many cases, the interface is moving in time, and so it is called moving boundary. Moving boundary problem is interesting and challenging problem from mathematical and also numerical view points, since we have to track moving boundaries as well as to solve governing model equations in each phase, in other words the mathematical problem will be stated as a initial and moving boundary problem for a prescribed model equations which is usually partial differential equations. In this talk, we will focus on moving plane curves mainly, and show how to track then numerically.

Topology

March 24th (Fri) Conference Room IV

10:00–12:00

1 Yusuke Mizota (Kyushu Sangyo Univ.) Remarks on C^∞-liftable vector fields 15

Summary: The notion of liftable vector fields for a mapping was introduced by Arnol'd. They have applications to classification problems of singularities. Recently, a systematic method to construct generators for the module of liftable vector fields for a multigerm of finite multiplicity was given in the real analytic case. In this talk, we show the method can not work well in the real C^∞ case.

2 Takashi Sano (Hokkai-Gakuen Univ.)
Mahito Kobayashi (Akita Univ.)
Minoru Yamamoto (Hirosaki Univ.) Panorama view for a polygon 15

Summary: We introduce a geometric transformation for a closed piecewise linear (PL) curve in $\mathbb{R}^2$ called *panorama view* to study shape of a polygon, or a simple closed PL curve. Basic features of a polygon C such as the number of inflection edges and bi-tangent lines *etc* can be detected instantly from it. We note that two basic formulae on the shape of a polygon by Crofton and Banchoff can be obtained naturally from the panorama view.

3 Yutaro Kabata (Hokkaido Univ.)
Martín Barajas (ICMC-USP) Projection of crosscap 15

Summary: We are concerned with local geometry of orthogonal projection of crosscap. The apparent contours (the critical value sets of the projections) of crosscaps were well studied in the previous literatures through discussions with $\mathcal{A}$-equivalence. However we loose some geometrical information of crosscaps such as behaviors of the double point curves when considering just $\mathcal{A}$-equivalence. In the present work, we consider J. West's classification of submersions $\mathbb{R}^3, 0 \to \mathbb{R}^2, 0$ by local coordinate changes where the coordinate changes of the source space preserves the standard crosscap. By using West's classification, we show the complete bifurcation diagrams of the apparent contours of generic crosscaps with the information of the crosscap points and the double point curves.

4 Shunsuke Ichiki (Yokohama Nat. Univ.) Composing generic linearly perturbed mappings and immersions/injections 15

Summary: Let f be an immersion of a manifold N into an open subspace U of $\mathbb{R}^m$. Let $F : U \to \mathbb{R}^\ell$ be a mapping. Generally, the composition $F \circ f$ does not necessarily yield a transverse mapping to a given subfiber-bundle of $J^1(N, \mathbb{R}^\ell)$. Nevertheless, for any $\mathcal{A}^1$-invariant fiber, composing generic linearly perturbed mappings of F and the given immersion f yields a transverse mapping to the subfiber-bundle of $J^1(N, \mathbb{R}^\ell)$ with the given fiber. Moreover, we give a specialized transversality theorem on crossings of compositions of generic linearly perturbed mappings of a given mapping $F : U \to \mathbb{R}^\ell$ and a given injection $f : N \to U$. Furthermore, applications of the two main theorems are given.

5 Huhe Han (Yokohama Nat. Univ.) The Wulff construction for convex integrands 15
Takashi Nishimura (Yokohama Nat. Univ.)

Summary: For any given Wulff shape $\mathcal{W}$, we can define the unique continuous function $S^n \to \mathbb{R}_+$ called convex integrand, denoted by $\gamma_{\mathcal{W}}$. In this paper, we show that, for any Wulff shapes $\mathcal{W}_1$ and $\mathcal{W}_2$, the equality $d(\gamma_{\mathcal{W}_1}, \gamma_{\mathcal{W}_2}) = h(\mathcal{W}_1, \mathcal{W}_2)$ holds, where d is the maximum distance of the function space consisting of convex integrands and h is the Pompeiu–Hausdorff distance of the space consisting of Wulff shapes.

6 Takahiro Yamamoto (Kyushu Sangyo Univ.) Singular fibers of stable maps on manifold pairs and its applications 15
Osamu Saeki (Kyushu Univ.)

Summary: Let (M, N) be a two colored manifold pair, where M is a closed 3-dimensional manifold and N is a closed 2-dimensional submanifold of M. In this talk, we show classification result of singular fibers of stable maps of (M, N) into surfaces, and obtain certain cobordism invariants for Morse functions on manifold pairs (V, W), where V is a closed surface and W is a closed 1-dimensional submanifold of V.

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

Mitsunobu Tsutaya (Kyushu Univ.) Applications of Stasheff's A_∞-theory to Lie groups

Summary: Stasheff introduced A_n-spaces as spaces equipped with a continuous unital binary operation satisfying the higher homotopy commutativity of degree n in certain sense. Related to this, various higher homotopy commutativities have been studied as well. In this talk, we review such higher homotopy properties and study related mapping spaces and applications to Lie groups, which contain the recent results of the speaker and of the joint work with Sho Hasui and Daisuke Kishimoto.

15:30–17:00

7 Jin-ho Lee (Samsung Fire / Marine Insurance) The generators on 23-th, 24-th and 25-th homotopy groups of the n-th rotation group 15
Toshiyuki Miyauchi (Fukuoka Univ.)
Juno Mukai (Shinshu Univ.*)
Mariko Ohara (Shinshu Univ.)

Summary: In this research, we determine generators on 2-primary component of 23-th, 24-th and 25-th homotopy groups of n-th rotation group by using lifts of generators on the homotopy groups of sphere with respect to EHP sequences.

8 Hisao Kato (Univ. of Tsukuba) Topological entropy and indecomposability of continua 15

Summary: This is a joint work with U. Darji. We use recent developments in local entropy theory to prove that positive topological entropy implies the existence of chaos in dynamical systems and complicated structures (indecomposability) in the underlying spaces.

9 Atsuhide Mori (Osaka Dental Univ.) Topology of information geometry 15

Summary: We begin a global study on information geometry. Take a n-dimensional smooth family of probability distributions with parameter space U. The relative differential entropy defines a separating premetric on U which is called the Kullback–Leibler divergence in information geometry. Then the small distance defines differential geometric structures on U. We restrict ourselves to the case of the space of the normal distributions and relate the setting of information geometry to the topology of Anosov foliations and bi-contact structures on Sol^3-manifolds.

10 Shun Wakatsuki (Univ. of Tokyo) On the semi-purity of Sullivan algebras 15

Summary: Félix and Thomas extended the loop products and coproducts to simply-connected Gorenstein spaces. Previously, we explicitly described the loop product and coproduct of a rational Gorenstein space which has a semi-pure Sullivan model. In this talk, we prove that every simply connected space with finite dimensional rational homotopy groups has a semi-pure Sullivan model. Moreover, we give a generalization of a result on a triviality of the loop coproduct.

11 Shin Kiriki (Tokai Univ.)
Teruhiko Soma (Tokyo Metro. Univ.) Takens' last problem and existence of non-trivial wandering domains 15

Summary: We give an answer to a C^r $(2 \leq r < \infty)$ version of the open problem of Takens in [*Nonlinearity* (2008)] related to historic behavior of dynamical systems. To obtain the answer, we show the existence of non-trivial wandering domains near a homoclinic tangency, which is conjectured by Colli–Vargas [*Ergod. Th. Dynam. Sys.* (2001)]. Concretely speaking, it is proved that any Newhouse open set in the space of C^r-diffeomorphisms on a closed surface is contained in the closure of the set of diffeomorphisms which have non-trivial wandering domains whose forward orbits have historic behavior. Moreover, this result implies an answer in the C^r category to one of the open problems of van Strien [*Discrete Conti. Dynam. Sys.* (2010)] which is concerned with wandering domains for Hénon family.
The paper will be published from *Advances in Math.*, **306** (2017), 524–588.

March 25th (Sat) Conference Room IV

10:00–11:50

12 Erika Kuno (Tokyo Tech) Abelian subgroups of the mapping class groups for non-orientable surfaces 10

Summary: Birman–Lubotzky–McCarthy proved that all abelian subgroups of the mapping class groups for orientable surfaces are finitely generated and found the maximal torsion-free rank of them. We apply Birman–Lubotzky–McCarthy's arguments to the mapping class groups for non-orientable surfaces. We especially find a finitely generated group isomorphic to a given torsion-free subgroup of the mapping class groups and the maximal torsion-free rank of the abelian subgroups.

Summary: We prove that each Torelli group of an orientable surface with any number of boundary components is at least exponentially distorted in the mapping class group by using Broaddus–Farb–Putman's techniques. Further we show that the distortion of each Torelli group in the level d mapping class group is the same as that of in the mapping class group.

Summary: We give a simple infinite presentation for the mapping class group of a non-orientable surface with boundary components. The presentation is a generalization of the presentation given by the second author. We also give a finite presentation for the mapping class group of a non-orientable surface with boundary components to use in the proof of main result.

Summary: We give a small generating set for the twist subgroup of the mapping class group of a non-orientable surface by Dehn twists. The difference between the number of the generators and a lower bound of numbers of generators for the twist subgroup by Dehn twists is one. The lower bounds is obtained from an argument of Hirose.

Summary: We construct two $\mathbb{Z}$-module homomorphisms j and J from the abelianization of the Torelli group $\mathcal{I}(N_{g,1})$ of a non-orientable surface $N_{g,1}$ of genus $g \geq 4$ and with connected boundary to some free generated $\mathbb{Z}$-modules. The $\mathbb{Z}$-module homomorphism j is called the Johnson homomorphism, which is defined by Johnson in the case of an oriented surface. The homomorphism J has more precise information than the homomorphism j, in other words, $\ker J \subsetneq \ker j$. By the homomorphism J, we have $\dim(\mathbb{Q} \otimes (\mathcal{I}(N_{g,1})/[\mathcal{I}(N_{g,1}), \mathcal{I}(N_{g,1})])) \geq \frac{(g-1)(g-2)(g-3)}{6} + \frac{g(g-1)^2}{2}$.

Summary: We construct an embedding of the Torelli group of a compact connected oriented surface with non-empty connected boundary into the completed Kauffman bracket skein algebra of the surface. This embedding gives a new construction of the first Johnson homomorphism and the core of the Casson invariant.

Summary: We construct an embedding of the Torelli group of a compact connected oriented surface with non-empty connected boundary into the completed Kauffman bracket skein algebra of the surface. Using this, we give a new construction of an invariant $z(M) = 1 + a_1(A^4-1) + a_2(A^4-1)^2 + a_3(A^4-1)^3 + \cdots \in \mathbb{Q}[[A^4-1]] = \mathbb{Q}[[A+1]]$ for an integral homology 3-sphere M.

13:15–14:45

19 Mari Hataoka (Japan Women's Univ.) A presentation of a symmetric handlebody group 15

Summary: In this talk we consider a certain double covering of a handlebody of genus 2 and define a symmetric handlebody group as a subgroup of the handlebody group of the total space of the covering. We give a finite presentation of the symmetric handlebody group. We use a finite presentation of the handlebody group of genus 2 obtained by Hirose and the Reidemeister–Schreier method.

20 Teruaki Kitano (Soka Univ.)
Anh T. Tran (Univ. of Texas at Dallas) On the polynomial defined by $SL(2;\mathbb{C})$-Reidemeister torsion for Brieskorn homology 3-spheres 10

Summary: Let M be a closed 3-manifold. We consider Reidemeister torsion for $SL(2;\mathbb{C})$-irreducible representations of $\pi_1(M)$. Assume the set of values of Reidemeister torsions is a finite set. Then we can define the polynomial whose zero set coincides with the set of values of Reidemeister torsion for $SL(2;\mathbb{C})$-representations. For Brieskorn homology 3-sphere $\Sigma(p,q,r)$, we give the expression of the polynomial by using normalized Chebychev polynomials of second kinds.

21 Masakazu Teragaito (Hiroshima Univ.)
Kimihiko Motegi (Nihon Univ.) Generalized torsion elements and bi-orderability of 3-manifold groups 10

Summary: It is known that a bi-orderable group has no generalized torsion element, but the converse does not hold in general. We conjecture that the converse holds for the fundamental groups of 3-manifolds, and verify the conjecture for non-hyperbolic, geometric 3-manifolds. We also confirm the conjecture for some infinite families of closed hyperbolic 3-manifolds. In the course of the proof, we prove that each standard generator of the Fibonacci group $F(2,m)$ $(m>2)$ is a generalized torsion element.

22 Tatsuro Shimizu (Kyoto Univ.) On the SU(2) Chern–Simons perturbation theory 10

Summary: We define an obstruction to construct the G Chern–Simons perturbation theory by using Bott–Cattaneo's method. We prove that this obstruction is vanishing for $G=SU(2)$.

23 Tomohiro Asano (Univ. of Tokyo) The transverse element in the symplectic Khovanov homology 15

Summary: Plamenevskaya defined an invariant of transverse links in the standard contact S^3 as an element of the Khovanov homology of the link. We have defined the counterpart in the symplectic Khovanov homology and have proven some basic properties.

March 26th (Sun) Conference Room IV

10:00–12:00

24 Tomo Murao (Univ. of Tsukuba) The complete connected component decomposition of quandles ····· 10
Yusuke Iijima (Univ. of Tsukuba)

Summary: A quandle is a set with a binary operation satisfying some properties. The number of quandle colorings is an invariant for oriented knots. An inner automorphism group of a quandle has an action to the quandle naturally. In general, we call an orbit of the quandle by the action its connected component. All elements of a quandle used by a coloring of an oriented knot are in its connected component by the definition of quandle colorings. However, a connected component of a quandle is its subquandle, but not a connected quandle. In this talk, we show that a decomposition of a quandle into its maximal connected subquandles is unique, and we give some examples.

25 Atsushi Ishii (Univ. of Tsukuba) The algebraic structure of a partially multiplicative biquandle ····· 10
Masahide Iwakiri (Saga Univ.)
Seiichi Kamada (Osaka City Univ.)
Jieon Kim (Osaka City Univ.)
Shosaku Matsuzaki (Waseda Univ.)
Kanako Oshiro (Sophia Univ.)

Summary: A primitive partially multiplicative biquandle is a biquandle with a partial multiplication which was introduced to define biquandle colorings for handlebody-knots. We reformulate it to bring out its algebraic structure well. We extends the notion of an n-parallel biquandle operation for every integer n, which gives us a series of partially multiplicative biquandles for a given biquandle.

26 Yusuke Takimura A pre-order of chord diagrams on knot projections ····· 15
(Gakushuin Boys' Junior High School)

Summary: We introduce a new pre-order on the set of all chord diagrams on knot projections.

27 Noboru Ito (Univ. of Tokyo) Spaces of chord diagrams on spherical curves II ····· 15

Summary: In this talk, we obtain a framework to produce (possibly infinitely many) new topological invariants of oriented spherical curves under some Reidemeister moves. They are obtained by chord diagrams, each of which is a configuration of paired points consisting of a head and a tail.

Summary: For an effectively n-colorable knot K, the n-palette number of K, denoted by $\mathrm{C}_n^*(K)$, is the minimum number of distinct colors used over all effective n-colorings of K. It is known that $\mathrm{C}_n^*(K) \geq 2 + \lfloor \log_2 n \rfloor$ for any effectively n-colorable knot K. For $n = 3, 5, 7, 9, 11, 13$, any effectively n-colorable knot K satisfies $\mathrm{C}_n^*(K) = 2 + \lfloor \log_2 n \rfloor$. In our previous work, for any odd integer $n \geq 3$, we show that any effectively n-colorable torus knot T satisfies $\mathrm{C}_n^*(T) = 2 + \lfloor \log_2 n \rfloor$. In this talk, we show that any effectively n-colorable 2-bridge knot has the same property.

Summary: J. Milnor defined a family of link invariants indexed by sequences, and gave an algorithm to compute these invariants by using the Wirtinger presentation of a given link.
M. Wada considered some group presentations obtained from a link diagram, and proved that groups derived from these presentations are invariants of the link. We can regard one of Wada's presentations as a generalization of the Wirtinger presentation. In this talk, we define link invariants of Milnor type by using the Wada's presentation.

Summary: By the Fox's re-embedding theorem, any compact submanifold of the 3-sphere can be re-embedded in the 3-sphere so that it is unknotted. It is unknown whether the Fox's re-embedding can be replaced with twistings. In this paper, we will show that any closed 2-manifold embedded in the 3-sphere can be unknotted by twistings. In spite of this phenomenon, we show that there exists a compact 3-submanifold of the 3-sphere which cannot be unknotted by twistings. This shows that the Fox's re-embedding cannot always be replaced with twistings.

Summary: In this talk we consider a jenga game as a sequence of polytopes and their genera. We generalize the game to the (n, k)-game and determine the maximum genus of the (n, k)-game.

14:15–15:45

32 Akiko Shima (Tokai Univ.) Regions without crossings for minimal charts 15
Teruo Nagase (Tokai Univ.*)

Summary: For a label m of a chart Γ we denote by Γ_m the union of all the edges of label m and their vertices. For a minimal chart Γ with exactly two crossings, we can show that the two crossings are contained in $\Gamma_\alpha \cap \Gamma_\beta$ for some labels $\alpha < \beta$. To propose a normal form for a minimal chart with two crossings, we study the structure of a disk D not containing any crossing but satisfying $\Gamma \cap \partial D \subset \Gamma_{\alpha+1} \cup \Gamma_{\beta-1}$.

33 Kouki Sato (Tokyo Tech) A full-twist formula for the ν^+-invariant 15

Summary: Hom and Wu introduced a knot concordance invariant called ν^+-*invariant*, which dominates many concordance invariants derived from Heegaard Floer homology. In this work, we give a full-twist formula for the ν^+-invariant. By using the formula, we extend Wu's cabling formula for the ν^+-invariant (which is proved only for particular positive cables) to all cables in the form of an inequality. In addition, we also discuss ν^+-*equivalence*, which is an equivalence relation on the knot concordance group. We introduce a partial order on ν^+-equivalnce classes, and study the relationship between the partial order and full-twists.

34 Kouki Sato (Tokyo Tech) CP^2-sliceness and Floer homologically thin knots 15

Summary: If a knot in S^3 has thin knot Floer homology, we say that the knot is thin. In this work, We consider which thin knots can bound a disk in $CP^2 - B^4$, and give some obstructions to bounding such a disk. By using the obstructions, we determine which $(2, q)$-torus knots bound a disk in $CP^2 - B^4$. In addition, we also consider which full-twists can preserve the thinness.

35 Motoo Tange (Univ. of Tsukuba) Slice-ribbon conjecture and handle slide 15
Tetsuya Abe (Osaka City Univ.)

Summary: A ribbon disk is an immersed disk in the 3-sphere with only ribbon singularities and the boundary is called a ribbon knot. A slice disk is a proper embedded disk in the 4-ball and the boundary is called a slice knot. It is well known that any ribbon knot is slice knot. However, whether any slice knot is ribbon or not is an open question. In this talk, we show that if the handle decomposition of the 4-ball associated with a slice disk is trivialized into the empty handle decomposition of the 4-ball without opposite 3-handle slides over 2-handles, then the slice knot is ribbon.

36 Syunji Moriya (Osaka Pref. Univ.) The space of short ropes and the classifying space of the space of long
Keiichi Sakai (Shinshu Univ.) knots 15

Summary: The space of short ropes was introduced by J. Mostovoy in 2002. He proved that the fundamental group of the space of short ropes is the group completion of the monoid of isotopy classes of knots and conjectured that the space is the classifying space of the space of long knots. We prove his conjecture affirmatively. This is a joint work with Keiichi Sakai (Shinshu University).

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

Yasuyuki Miyazawa (Yamaguchi Univ.) Links with trivial Q-polynomial

Summary: For a classical knot or link, there are several well-known polynomial invariants: the Alexander polynomial, the Conway polynomial, the Jones polynomial, the HOMFLY polynomial, the Q-polynomial and the Kauffman polynomial.

A polynomial invariant for a μ-component link is *trivial* if the polynomial is identical with that of the trivial μ-component link.

The existence of nontrivial knots or links with trivial Alexander polynomials, and the existence of nontrivial links (not a knot) with trivial Jones polynomials are known.

"Does there exist a non-trivial knot indistinguishable from the trivial knot by the Q-polynomial?" It has been an open problem for 30 years since Brandt, Lickorish, Millett and Ho introduced the Q-polynomial for unoriented knots and links around in 1985.

In this talk, we give the following affirmative answer on the problem.

"There exists a non-trivial knot with trivial Q-polynomial."

Furthermore, we reveal there exist infinitely many prime knots and links with trivial Q-polynomial and so Q-polynomial does not detect trivial links.

Infinite Analysis

March 26th (Sun) Conference Room Ⅲ

10:30–11:30

1 Akishi Kato (Univ. of Tokyo)
Yuma Mizuno (Tokyo Tech)
Yuji Terashima (Tokyo Tech)
Quiver mutation sequences and q-binomial identities · · · · · · · · · · · · · · · 15

Summary: In this talk, we introduce a quantity called a partition function for a quiver mutation sequence. The partition function is a generating function whose weight is a q-binomial associated with each mutation. We show that the partition function can be expressed as a ratio of products of quantum dilogarithms. This provides a systematic way of constructing various q-binomial multisum identities.

2 Ryosuke Kodera (Kyoto Univ.)
Higher level Fock spaces and affine Yangian · 15

Summary: We construct actions of the affine Yangian of type A on higher level Fock spaces.

3 Katsuyuki Naoi
(Tokyo Univ. of Agri. and Tech.)
Noncommutativity between the operations of taking tensor products and classical limits of $U_q(\mathbf{L}\mathfrak{g})$-modules · 15

Summary: Given a module V over a quantum loop algebra $U_q(\mathbf{L}\mathfrak{g})$, an $\mathbf{L}\mathfrak{g}$-module $\overline{V}$ called the classical limit is obtained by specializing the parameter q to 1. One difficulty in studying classical limits is the noncommutativity between the operations of taking tensor products and classical limits. Namely, for $U_q(\mathbf{L}\mathfrak{g})$-modules $V_1, \dots, V_p$, $\overline{V_1 \otimes \cdots \otimes V_p}$ is not necessarily isomorphic to $\overline{V_1} \otimes \cdots \otimes \overline{V_p}$. In this talk, when all V_i are Kirillov–Reshetikhin modules, we show that the classical limit $\overline{V_1 \otimes \cdots \otimes V_p}$ can be described using the notion of fusion product, which is a graded analog of a tensor product of modules over the current algebra $\mathfrak{g} \otimes \mathbb{C}[t]$.

4 Yoshihiro Takeyama
(Univ. of Tsukuba)
On the eigenfunctions for the multi-species q-Boson system · · · · · · · · · · 15

Summary: In a previous paper a multi-species version of the q-Boson stochastic particle system is introduced and the eigenfunctions of its backward generator are constructed by using a representation of the Hecke algebra. In this talk I give a formula which expresses the eigenfunctions by means of the q-deformed bosonic operators.

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

Ivan Chi Ho Ip (Kyoto Univ.) Positive representation and cluster realization of quantum groups

Summary: The finite dimensional representation theory of compact quantum group is well-known and possesses many nice properties, while that of split real quantum group is a lot more complicated due to non-compactness. However, a special class of representations of $U_q(sl(2,R))$, which was studied by Teschner et al from the Physics point of view, demonstrates a lot of properties in parallel to the compact case. In a joint work with I. Frenkel, we introduce the notion of positive representations of split real quantum groups, generalizing the ones by Teschner et al. These are characterized by the use of positive self-adjoint operators acting on certain Hilbert space.

As a consequence of the construction, recently we discover an embedding of $U_q(g)$ into certain quantum cluster algebra associated to a disk with one puncture and two marked points, where the generators of $U_q(g)$ can be explicitly presented visually by certain paths on the quiver. Furthermore, we discover a new factorization formula of the universal R matrix, which is naturally realized as quiver mutations giving the half Dehn-twist of the triangulation on a disk with two punctures and two marked points. This generalizes the work of Schrader and Shapiro in the case of type A, and is closely related to the cluster structures of the moduli space of G-local system discovered recently by Le.

15:30–16:30 Talk Invited by Infinite Analysis Special Session

Akishi Kato (Univ. of Tokyo) Quiver mutation loops and partition q-series

Summary: Quivers and their mutations are ubiquitous in mathematics and mathematical physics; they play a key role in cluster algebras, wall-crossing phenomena, gluing of ideal tetrahedra, etc. It is thus very important to capture quantitatively a common structure hidden in various guises of quiver mutations.

Recently, we introduced a partition q-series for a quiver mutation loop (a loop in a quiver exchange graph) using the idea of state sum of statistical mechanics. The partition q-series are defined as a sum over states on a graph generated by the sequential evolution of the quiver; the weight of a state is given by the product of all local weights associated with each mutation steps.

The partition q-series depend only on the combinatorial structures of quiver mutation sequences, and enjoy some nice properties such as pentagon move invariance. We also discuss their relation with combinatorial Donaldson–Thomas invariants, q-dilogarithms, as well as fermionic character formulas of certain conformal field theories. This is a joint work with Yuji Terashima (Tokyo Institute of Technology). If time permits, I will also talk about our recent work with Yuya Mizumo (Tokyo Institute of Technology).

References:

(1) A. Kato, Y. Terashima, "Quiver mutation loops and partition q-series" Comm. Math. Phys. **336** (2015) 811–830 [arXiv:1403.6569]

(2) A. Kato, Y. Terashima "Quantum dilogarithms and partition q-series" Comm. Math. Phys. **338** (2015) 457–481 [arXiv:1408.0444]

(3) A. Kato, Y. Mizuno, Y. Terashima "Quiver mutation sequences and q-binomial identities" preprint [arXiv:1611.05969]

March 27th (Mon) Conference Room III

10:15–12:00

5 Hiroshi Kawakami (Aoyama Gakuin Univ.) The complete degeneration scheme of the four-dimensional Painlevé-type equations ····· 15

Summary: In the joint work with H. Sakai and A. Nakamura, we constructed the degeneration scheme of four-dimensional Painlevé-type equations associated with unramified linear equations. In this talk I present the "complete" degeneration scheme of the four-dimensional Painlevé-type equations, which is constructed by means of the degeneration of HTL forms of associated linear equations.

6 Hidehito Nagao (Akashi Coll. of Tech.), Yasuhiko Yamada (Kobe Univ.) On q-Garnier systems ····· 15

Summary: We have studied some simple expressions of time evolution equations, scalar Lax pairs and determinant formulae of hypergeometric special solutions for the corresponding q-difference Garnier systems. These Lax pairs are equivalent to Sakai's 2×2 matrix Lax form for the q-Garnier system and Suzuki's $(2N+2) \times (2N+2)$ matrix Lax form for the higher order q-Painlevé system.

7 Hidehito Nagao (Akashi Coll. of Tech.), Yasuhiko Yamada (Kobe Univ.) Reductions from q-Garnier systems to q-Painlevé systems ····· 15

Summary: We have studied some simple expressions of time evolution equations, scalar Lax pairs (and determinant formulae of hypergeometric special solutions) for the corresponding q-difference Garnier systems. We also have studied reductions from q-Garnier systems to q-Painlevé systems. We will discuss reductions to q-Painlevé systems of types $D_5^{(1)}$, $E_6^{(1)}$ and $E_7^{(1)}$.

8 Genki Shibukawa (Osaka Univ.) A generalization of multivariate Meixner, Charlier and Krawtchouk polynomials ····· 15

Summary: In [G. Shibukawa, J. Lie Theory, (2016)], we introduced some multivariate analogues of Meixner, Charlier and Krawtchouk polynomials, and established their main properties. Their proofs are based on harmonic analysis on symmetric cones, and we need a restriction for the coupling constant. In today's talk, we give a generalization of the main properties of the multivariate Meixner polynomials etc. for an arbitrary positive real value of the coupling constant.

9 Yousuke Ohyama (Tokushima Univ.) q-Stokes phenomenon of q-hypergeometric series ${}_2\varphi_0(a, 0; -; q, x)$ ····· 15

Summary: We study a connection problem of a q-difference equation which is satisfied by the q-hypergeometric series ${}_2\varphi_0(a, 0; -; q, x)$. We give a resummation of the divergent series ${}_2\varphi_0(a, 0; -; q, x)$ and show a connection formula.

10 Yousuke Ohyama (Tokushima Univ.) q-Stokes phenomenon of q-hypergeometric series ${}_1\phi_1(0; a; q, x)$ ····· 15

Summary: We study a connection problem of a q-difference equation which is satisfied by the q-hypergeometric series ${}_1\phi_1(0; a; q, x)$. We give a resummation of a divergent series solution of this equation and show a connection formula.