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The Mathematical Society of Japan

2020 Autumn Meeting

Titles and Short Summaries of the Talks

September, 2020

2020 The Mathematical Society of Japan

AUTUMN MEETING

Dates: September 22nd (Tue)–25th (Fri), 2020

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The Mathematical Society of Japan

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Plenary Talks

September 23rd (Wed)

The 2020 MSJ Autumn Prize

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

Masayoshi Takeda (Kansai Univ.) Dirichlet forms and symmetric Markov processes with tightness property ..... (16:30–17:30)

Summary: We introduce a class of symmetric Markov processes. A symmetric Markov process X on a locally compact separable metric space E is said to be in Class (T) if it is irreducible, resolvent strong Feller, and possesses a tightness property, i.e., for any $\epsilon > 0$, there exists a compact set $K \subset E$ such that $\sup_{x \in E} R_1 1_{K^c}(x) \leq \epsilon$. Here 1_{K^c} is the indicator function of the complement of K and R_1 is the 1-resolvent of X.

We show some spectral properties of a symmetric Markov process in Class (T): the compactness of the semi-group, the bounded continuity of every eigenfunction, the integrability of the principal eigenfunction, p-independence of growth bounds of the semigroup.

The definition of the tightness property tells us that the two cases occur; X stays on a compact set K for almost all time or explodes fast. More precisely, if X is conservative, the tightness property implies a very strong recurrence property (*uniform hyper-exponential recurrence*): the process X quickly reaches each compact set from infinity. On the other hand, if X is not conservative, the tightness property implies that the lifetime of X is exponentially integrable, and so the process quickly reaches infinity. By using these probabilistic properties, we can prove the uniform large deviations of Donsker-Varadhan type and the existence and uniqueness of quasi-stationary distributions for each case.

Applying these facts above to time-changed processes, we can give a necessary and sufficient condition for the integrability of Feynman-Kac functionals or the stability of Gaussian bounds in terms of the principal eigenvalue of the time changed processes.

Featured Invited Talks

September 22nd (Tue)

Makoto Masumoto (Yamaguchi Univ.) Continuations of Riemann surfaces ····· (13:00–14:00)

Summary: Let R_0 be a Riemann surface of finite genus g. A continuation of R_0 is, by definition, a pair (R, ι) of a Riemann surface R and a conformal embedding ι of R_0 into R. We are mainly concerned with the case where R_0 is an open Riemann surfaces of finite genus g.

If $g = 0$, then the general uniformization theorem assures us that R_0 is conformally equivalent to a domain on the Riemann sphere. In 1928 Bochner generalized it to the case of higher genus in his study on continuations of Riemann surfaces, showing that R_0 can be realized as a subdomain of a closed Riemann surface of the same genus g. While a closed Riemann surface of genus zero is essentially unique, this is not the case for closed Riemann surfaces of positive genus. It is then natural to ask into which closed Riemann surfaces of genus g the Riemann surface R_0 can be conformally embedded.

Heins first tackled the problem for $g = 1$, and proved in 1953 that the set of closed Riemann surfaces of genus one giving a continuation of R_0 is relatively compact in the moduli space of genus one. Four years later Oikawa formulated the problem in the context of Teichmüller theory, and discovered that the set $\mathfrak{M}(R_0)$ of marked closed Riemann surfaces of genus g into which R_0 can be mapped by a conformal embedding preserving markings is compact and connected in the Teichmüller space $\mathfrak{T}_g$ of genus g. In 1987 Shiba improved Oikawa's result in the case of genus one by deducing that Oikawa's set is in fact a closed disk in $\mathfrak{T}_1$, which may degenerate to a singleton, with respect to the Teichmüller distance.

Recently, we have been making great progress in the research on $\mathfrak{M}(R_0)$ for general g. In this talk we discuss, among other things, geometric properties of $\mathfrak{M}(R_0)$, characterizations of conformal embeddings of R_0 giving rise to boundary points of $\mathfrak{M}(R_0)$, and uniqueness of conformal embeddings of R_0 into closed Riemann surfaces of the same genus.

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

Summary: The concept of lattices was originally introduced and studied by August Bravais in botany and crystallography. Starting from the pioneer works of Bravais, I'd explain about several problems in modern crystallography and examples for actual applications of the theory of arithmetic quadratic forms I have obtained so far.

September 24th (Thu)

Yoshikazu Takada (Kumamoto Univ.*) Selection of the best population ····· (13:00–14:00)

Summary: We consider the problem of selecting the best one of several populations on the basis of observations from each population. The problem has generally been formulated adopting an approach known as the indifference-zone formulation. We also discuss the problem of selecting a subset containing the best population. First we consider normal populations, and discuss two cases. One is that the best population is the one with the largest mean, and the other is that the best population is the one with the smallest variance. Next we consider binomial populations, and select the best one with the highest probability of success. Finally, we consider the problem of selecting the best component of mean vector of a multivariate normal distribution and of selecting the best category of a multinomial distribution.

Nobuki Takayama (Kobe Univ.) Hypergeometric systems of several variables and statistics · (13:00–14:00)

Summary: Special functions such as incomplete gamma functions and error functions are used in statistics. Hypergeometric functions of several variables also appear in several questions in statistics. However, they had not been utilized for numerical evaluation of statistical quantities because the evaluation is not easy. Modern theoretical and computational studies of hypergeometric systems of several variables make the evaluation possible.

September 25th (Fri)

Osamu Hatori (Niigata Univ.*)$^{\flat}$ Isometries on Banach algebras ····· (13:00–14:00)

Summary: An isometry is a transformation which preserves the distance between elements of a space. In 1932 Banach exhibited that every surjective isometry T on the space of continuous real-valued functions on a compact metric space such that $T(0) = 0$ must have the form

$$T(f) = \lambda f \circ \varphi,$$

where λ is a unimodular function and φ is a homeomorphism. He establised a canonical form which fits in an astonishing number of cases. He, in fact, proved that an isometry preserves the algebraic structures of the underlying Banach algebras. In this talk we consider the problem "When does an isometry between Banach algebras as Banach spaces preserve the algebraic structures as Banach algebras?". Providing some history of the subject, my goal is to produce a useful resource for mathematicians who are interested in the subject. Due to my capability, probably I have underestimated the enormity of such subject, what I deliver in this talk is more of a sampler than a full-blown survey.

Ryushi Goto (Osaka Univ.)$^{\flat}$ On generalized Kähler geometry ····· (13:00–14:00)

Summary: A generalized Kähler structure on a manifold is a triple (g, I, J) consisting of a Riemannian metric g compatible with two complex structures I, J satisfying the certain conditions, which has an origin in a non-linear sigma model in Mathematical physics. However, a generalized Kähler structure has a natural description using the language of Hitchin's generalized complex geometry, which is a commutative pair $(\mathcal{J}_1, \mathcal{J}_2)$ of generalized complex structures equipped with a positivity condition. The deformation-stability theorem of generalized Kähler structures shows that every holomorphic Poisson structure on a compact Kähler manifold gives rise to nontrivial deformations of generalized Kähler structures. In Kähler geometry, Fujiki–Donaldson gave a nice description of scalar curvature as the moment map for hamiltonian diffeomorphisms. In generalized Kähler geometry, one does not have the good notions of Levi–Civita connection and curvature, yet there still exists a precise framework for moment map and scalar curvature is defined as the moment map. Then a fundamental question is to understand the existence or non-existence of generalized Kähler structures with constant scalar curvature.

We study automorphisms of generalized complex manifolds and show that the automorphisms is a reductive Lie group if there exists a generalized Kähler structure with constant scalar curvature. This is a generalization of Matsushima–Lichnerowicz obstruction theorem. We also discuss deformations of generalized Kähler structure with constant scalar curvature.

Foundation of Mathematics and History of Mathematics

September 24th (Thu)

9:30–10:35

1 Shigeru Masuda (Res. Workshop of Classical Fluid Dynamics) — Study of the Eulerian Integrals by Legendre ····· 15

Summary: (This is the same with that of the 2020's annual session.) Legendre issues *Traité des fonctions elliptiques et des intégrales eulériennes etc.* in 1825. In this books he discusses Eulerian Integral with two sorts of integrals, in relation to Euler's integrals, including his elliptic functions. Legendre complains Euler's integral, saying "they have never been occupied to make the calculation easy, nor to fix the degree of precision of which it is susceptible," (art. 169) and proposes that some functions are explained with the arcs of circle and of the logarithms. (art. 60, etc.)

2 Shigeru Masuda (Res. Workshop of Classical Fluid Dynamics) — The complete functions by Legendre ····· 15

Summary: (This is the same with that of the 2020's annual session.) In 1825, Legendre defines as the most important function among his elliptic functions, the complete function (=c.f.) F^1, E^1 and Π^1. Afterward in modern times, these functions are newly expressed with K, E and Π such as in the study of a quantum mechanics, where it shows as $F^1 = K$. We call E and Π c.f.s of newly defined versions, then $E = E^1, \Pi = \Pi^1$. Legendre uses the c.f. in variously applied arena, such as Geometry, Mechanics, Construction of the Tables, Eulerian Integrals, etc. We discuss the c.f. as the original by Legendre, his objects, effects, and so on. cf. Table 1.

3 Shigeru Masuda (Res. Workshop of Classical Fluid Dynamics) — Supplements of study of the elliptic functions and Eulerian Integrals by Legendre ····· 15

Summary: Legendre issues *Traité des fonctions elliptiques et des intégrales eulériennes etc.* in 1825. As the third volume, in 1828, he adds the primary, secondary and tertiary supplements. in which, he discusses mainly the theories on the elliptic functions of his and by Germany Jacobi and Norwegian Abel on the elliptic functions. These two younger mathematicians issue many challenging results in the same time, in respecting to Legendre's theory. Fifty-years-elder Legendre entertains misgivings that his troubles having constructed his theories since 1811, might come to nothing, because of fecundity of this branch. We will report what is his say at the last time in his life.

4 Hideyuki Majima (Ochanomizu Univ.*) — Towards the year 2022, the 314th memorial year of SEKI Takakazu ····· 15

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

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

Masahito Takase Shaping the fountains in Modern Western Mathematics

Summary: There are several impressive fountains in the history of the mathematics on which Modern Western Mathematics is founded as follows:

Descartes's method of normals
Fermat's method of tangents
Fermat's number theory
Leibniz's analysis of the infinity
Johann Bernoulli's beautiful formula $\frac{\log\sqrt{-1}}{\sqrt{-1}} = \frac{\pi}{2}$
Euler's observation on dividing 0 by 0
Euer's discovery of the concept of function
Gauss' idea of transfering number theory from rational numbers to Gaussian numbers
The concept of an Abelian equation discovered by Abel
Kronecker's "Jugendtraum"
Kummer's idea of ideal prime factors
Jacobi's inverse problem of Abelian integrals invented by Jacobi
Riemann's idea of Riemann surfaces
Hartogs' inverse problem invented by K. Oka

I will explain the significances of returning to the fountains and make a critical observation on comtemporary mathematics.

11:50–12:00 Mathematics History Team Meeting

14:20–16:10

5 Masaya Suzuki (UL Japan) Kleene's ternary logic and fail safe 10

Summary: Kleene's ternary logic system was devised to explain the behavior of recursive partial functions in his book. This approarch does not seem to the mainstream in the recursion theory, but the system have studied as a kind of multi-valued logic by mathematical philosophers. On the other hand, in the safety engineering, the same logical system as Kleene's ternary logic was devised for a completely different motivation. The motivation is to make electronic circuits fail safe. Fail safe is an important notion in preventing accidents. In this talk, we will see the relationship between these systems.

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

Summary: (This abstract is identical with the abstract of MSJ Spring Meeting 2020.) Involutivity, called double-negation axiom in classical logic, is one of the important additional axioms to intuitionistic substructural logics. In this talk, we consider a Gentzen-style formulation for some involutive non-associative substructural logics and show the cut elimination theorem. The logics in our formulation include contraposition axiom, regarded as a restricted associativity.

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

Summary: Following R. Smullyan, G. Boolos posed the puzzle "The Hardest Logic Puzzle Ever" (1996), and provided an answer in the form of "iff". After that, Roberts (2001) and Rabern–Rabern (2008) showed a simple solution to the puzzle by using the embedded question lemma. We introduce a formalization of such Knights and Knaves puzzles in term of propositional logic, and observe that the two answers by Boolos and Roberts–Rabern are essentially logically equivalent. This elegant method can be applied to an analysis of the puzzle in the fantasy film Labyrinth (1986) as well.

8 Tatsuya Shimura (Nihon Univ.) A simple proof of a stronger version of disjunction property ····· 15

Summary: We give a stronger version of disjunction property or intermediate propositional logics and give simple proofs for the results of Gabbay–de Jongh, Wroński and Chagrov–Zakharyashev only depends on the completeness of the intuitionistic propositional logic.

9 Yuya Okawa (Chiba Univ.)
Taishi Kurahashi (Kobe Univ.) Generalizations of Bennet's result on partially conservative sentences ····· 15

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

10 Taishi Kurahashi (Kobe Univ.)
Yuya Okawa (Chiba Univ.) Sublogics of the interpretability logic **IL** ····· 15

Summary: We study modal completeness and incompleteness of several sublogics of the interpretability logic **IL**. First, we introduce the sublogic $\mathbf{IL}^-$ which is valid in all $\mathbf{IL}^-$-frames. Then, we prove the modal completeness of twelve logics between $\mathbf{IL}^-$ and **IL** with respect to $\mathbf{IL}^-$-frames. At last, we prove that eight natural sublogics of **IL** are incomplete with respect to $\mathbf{IL}^-$-frames.

11 Katsumi Sasaki (Nanzan Univ.) Sequent systems without derivations with temporal assumptions ····· 15

Summary: In natural deduction system for classical propositional logic, there are some inference rules with temporal assumptions, e.g., implication introduction rule and disjunction elimination rule. Prawitz calls such inference rules improper inference rules, and the others proper inference rules. Here, we distinguish between improper and proper derivations. Specifically, we prove that any sequent system for classical propositional logic with only one inference rule cut does not allow improper derivations in general, while it allows proper ones. For instance, in such systems, the sequent $\Rightarrow p \to q$ can not derive from the sequent $p \Rightarrow q$ and axioms using cut. In order to prove the impossibility of improper derivations, we modify truth valuation and prove completeness for sequent systems having only one inference rule cut.

September 25th (Fri)

9:30–10:50

12 Tomoya Machide (Nat. Inst. of Information) On a formula for systems of Boolean polynomial equations and computational complexity ····· 15

Summary: It is known a method of transforming a system of Boolean polynomial equations to a single Boolean polynomial equation. In this talk, we prove a formula for systems of Boolean polynomial equations using this method. It is also known that a SAT problem (satisfiability problem), which is important in logic and computer science, can be transformed to a system of Boolean polynomial equations. We also give results of computational complexity using the formula.

13 Kenshi Miyabe (Meiji Univ.) The rate of convergence of computable inductions ····· 15

Summary: In the theory of inductive inference by Solomonoff, we consider the rate of convergence of computable prediction to the conditional model measure. The Kullback–Leibler divergence is used to measure the difference between the prediction and the model measure. The results show that, dominance is a necessary and sufficient condition to converge for a larger class of measures. The rates of convergence differ in different cases.

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

Summary: In ZF, we show that if there is a poset which forces the axiom of choice,then there is no Reinhardt cardinal.

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

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

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

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

12:10–12:30 Research Section Assembly

Algebra

September 22nd (Tue)

9:40–12:00

1 Takao Watanabe (Osaka Univ.) A gap of the exponents of repetitions of Sturmian words ····· 10
Suzue Ohnaka
(Naruo Senior High School)

Summary: By measuring the smallest second occuring time of every factor of an infinite word x, Bugeaud and Kim introduced a new quantity $\mathrm{rep}(x)$ called the exponent of repetition of x. Among other results, Bugeaud and Kim proved that $1 \leq \mathrm{rep}(x) \leq r_{\max} = \sqrt{10} - 3/2$ and $r_{\max}$ is the isolated maximum value when x varies over the Sturmian words. We determine the value r_1 such that there is no Sturmian word x satisfying $r_1 < \mathrm{rep}(x) < r_{\max}$ and r_1 is an accumulate point of the set of $\mathrm{rep}(x)$ when x runs over the Sturmian words.

2 Yasuhiro Terakado (Academia Sinica)[♭] Hecke eigensystems of automorphic forms (mod p) of Hodge type and algebraic modular forms ····· 10

Summary: We show that the systems of prime-to-p Hecke eigenvalues arising from automorphic forms (mod p) associated to an algebraic group $G/\mathbb{Q}$ of Hodge type are the same as those arising from algebraic modular forms (mod p) associated to an inner form of G. As an application we give an explicit upper bound for the number of the systems of Hecke eigenvalues of automorphic forms (mod p) associated to the similitude group G of a Hermitian form with a totally indefinite quaternionic multiplication. We also show that the superspecial locus of the moduli space of abelian varieties of this type, possibly having bad reduction at p, is non-empty. This is joint work with Chia-Fu Yu.

3 Toshiki Matsusaka (Nagoya Univ.) Trinity of the Eisenstein series ····· 15

Summary: We study the weight 2 parabolic/elliptic/hyperbolic Eisenstein series, which gives a harmonic/polar harmonic/locally harmonic Maass form, respectively. Furthermore, by means of the hyperbolic Eisenstein series, we can redefine the hyperbolic Rademacher symbol introduced by Duke–Imamoḡlu–Tóth. The symbol is expressed explicitly in terms of continued fraction coefficients of the corresponding two real quadratic irrationals.

4 Akio Nakagawa (Chiba Univ.) Artin L-functions of diagonal hypersurfaces and generalized hypergeometric functions over finite fields ····· 15

Summary: In this talk, I would like to talk about that the Artin L-function of a diagonal hypersurface D over a finite field associated to a character of a finite group acting on D can be expressed in terms of hypergeometric functions and Jacobi sums over the finite field. As an application, I would also like to talk about the Dwork hypersurfaces and relations among certain hypergeometric functions over different finite fields.

5 Genki Shibukawa (Kobe Univ.) Some singular values of the elliptic lambda function and incredible cubic identities ····· 10

Summary: We propose three kinds of explicit formulas for the elliptic lambda function by elliptic modular functions. Further, we derive incredible cubic identities as a corollary of our explicit formulas and evaluate some singular values of the elliptic lambda function.

6 Wataru Takeda (Nagoya Univ.) On a kind of solutions to the Erdős last equation ····· 10

Summary: We focus on the solutions to the Erdős last equation $n(x_1 + \cdots + x_n) = x_1 \cdots x_n$. Shiu classified the solutions into the class $C_l(n)$, where $l+1$ is the number of $x_i > 1$ and showed that $C_3(n)$ is non-empty if n is composite, or if $n \not\equiv 1 \bmod 1260$ and $n \geq 6$. We generalize Shiu's results for all l and show that $C_3(n)$ is non-empty if $n \not\equiv 1 \bmod 180180$.

7 Yasufumi Hashimoto (Univ. of Ryukyus) — Selberg's zeta function for the modular group in the critical strip · · · · 15

Summary: In this talk, we study the growth of Selberg's zeta function for the modular group in the critical strip.

8 Saburou Saitoh ♭ (Inst. of Reproducing Kernels/Gunma Univ.*), Tsutomu Matsuura (Gunma Univ.), Hiroshi Okumura — Values of the Riemann zeta function at positive integers by means of the division by zero calculus · · · · 10

Summary: This abstract is an arranged version of the 2020 annual meeting talk. In this talk, we will consider the values of the Riemann zeta function for any positive integers by means of the division by zero calculus. In particular, the values for odd positive integers were considered as mysterious ones, however, their values may be considered as in even integers case. We will give both analytical formulas and numerical results. A basic reference is given in the abstract, but we will talk more up-to-date information. Our purposes of this talk are to introduce of the division by zero calculus and to show its power.

9 Debika Banerjee (IIIT-Delhi), Yusuke Fujisawa, Makoto Minamide (Yamaguchi Univ.), Yoshio Tanigawa — On partial sum of Apostol's Möbius function · · · · 10

Summary: We shall consider an error term in asymptotic formula for the partial sum of Apostol's Möbius function. Without any unproved hypothesis, we shall improve an estimate of the error term which was obtained by Apostol.

10 Shigeru Iitaka (Gakushuin Univ.*), Hikaru Kajita (Azaminodaiichi Elementary School) — Quasi-Mersenne primes and super-perfect numbers NEO · · · · 10

Summary: If $q = p^e - p + 1 + m$ is a prime where p is a prime,then q are said to be quasi-Mersenne primes with base p and traslation parameter m. Given a prime p and an integer m, if positive integers a, A satisfy $A = \bar{p}\sigma(a) - p + 2 + m$ and $\sigma(A) = ap - p + 2 + m$, then a is said to be super-perfect number NEO.

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

Shuji Yamamoto (Keio Univ.) — Zeta values of totally real number fields and the Shintani generating class

Summary: In the study of the special values of Riemann zeta and Dirichlet L-functions at negative integers, it is important that these values have a common generating function, which is a simple rational function. For zeta values of arbitrary totally real number fields, similar generating functions were constructed by Shintani in 1970's. His idea of using a nicely chosen set of cones is really ingenious, but requires a non-canonical choice in the construction. Recently, to understand his construction in a more canonical way, Bannai, Hagihara, Yamada and the speaker have introduced the Shintani generating class, which is an equivariant cohomology class on a disjoint union of algebraic tori associated with the totally real field. This cohomology class is defined in a natural way, and generates zeta values just as in the case of the rational number field. In this talk, we will first review the classical result of the rational case and Shintani's work, then explain the construction of the Shintani generating class and how it generates zeta values.

15:30–16:30

11 Yugen Takegahara (Muroran Inst. of Tech.)
Fumihito Oda (Kindai Univ.)
Lattice Burnside rings 15

Summary: There are few generalizations of Burnside rings of finite groups which are abstract Burnside rings. Recently, we defined a lattice Burnside ring, which is a generalization of Burnside rings of finite groups and is an abstract Burnside ring, and obtained various results on the ring structure. The slice Burnside ring defined by S. Bouc is an example of a lattice Burnside ring, but we gave another new example and investigated the detailed ring structure.

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

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

13 Bernhard Mühlherr (Univ. Giessen)
Koji Nuida (Univ. of Tokyo)
Locally finite continuations and Coxeter groups of infinite ranks 15

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

September 23rd (Wed)

10:00–12:00

14 Makoto Enokizono (Tokyo Univ. of Sci.)
Tatsuya Horiguchi (Osaka City Univ.)
Takahiro Nagaoka (Kyoto Univ.)
Akiyoshi Tsuchiya (Univ. of Tokyo)
Uniform bases for ideal arrangements 15

Summary: In this talk, we explain uniform bases for the ideal arrangements. In particular, explicit uniform bases are presented on each Lie type. Combining the explicit uniform bases with the work of Abe–Horiguchi–Masuda–Murai–Sato, we also obtain explicit presentations of the cohomology rings of regular nilpotent Hessenberg varieties in all lie types.

15 Makoto Enokizono (Tokyo Univ. of Sci.)
Tatsuya Horiguchi (Osaka City Univ.)
Takahiro Nagaoka (Kyoto Univ.)
Akiyoshi Tsuchiya (Univ. of Tokyo)
An additive basis for the cohomology rings of regular nilpotent Hessenberg varieties 10

Summary: In this talk, we explain an additive basis for the cohomology ring of a regular nilpotent Hessenberg variety which is obtained by extending all cohomology classes of smaller regular nilpotent Hessenberg varieties. In particular, all of the cohomology classes of smaller regular nilpotent Hessenberg varieties are linearly independent.

Summary: The g-vectors of two-term presilting complexes are important invariant. We study a fan consisting of all g-vectors for a complete gentle algebra. We show that any complete gentle algebra is g-tame, by definition, its fan is dense. Our main ingredients are their surface model and their asymptotic behavior under Dehn twists. On the other hand, it is known that any complete special biserial algebra is a factor algebra of a complete gentle algebra and the g-tameness is preserved under taking factor algebras. As a consequence, we get the g-tameness of complete special biserial algebras.

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

Summary: For a Frobenius algebra, there are two ways of defining its Tate–Hochschild cohomology: the first way uses the notion of complete resolutions; the second makes use of the one of singularity categories. In the 1990s, using a certain complete resolution of a given Frobenius algebra, Sanada showed that the Tate–Hochschild cohomology algebra based on the complete resolution is a graded commutative algebra. On the other hand, Wang recently proved that the Tate–Hochschild cohomology algebra based on the singularity category of the enveloping algebra of a Frobenius algebra is also graded commutative. In this talk, we will show the existence and the uniqueness of cup product on Tate–Hochschild cohomology for arbitrary complete resolution of a Frobenius algebra and prove that the two Tate–Hochschild cohomology algebras are isomorphic.

Summary: Preprojective algebras have developed representation theory of quantum groups for symply-laced cases in many years. Recently, Geiß–Leclerc–Schröer defined preprojective algebras for any symmetrizable GCM and its symmetrizer. Certain varieties which consist of specific modules on these algebras describe crystal structures via their irreducible components and constructible functions. In this talk, we give nice stratifications of these varieties describing Lusztig's PBW parametrizations of canonical bases for non-simply laced cases, and then we try to give the polytopal descriptions of these parametrizations in Grothendieck groups of module categories on generalized preprojective algebras.

Summary: We construct a homomorphism from the affine super Yangian $Y_{\varepsilon_1,\varepsilon_2}(\widehat{\mathfrak{sl}}(m|n))$ to the universal enveloping algebra of a rectangular W-superalgebra $W^k(\mathfrak{gl}(ml|nl),(l^{(m|n)}))$ for all $m \neq n$ and $m,n \geq 2$. We also show that the image of this homomorphism is dense provided that $k+(m-n)(l-1) \neq 0$.

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

Soichi Okada (Nagoya Univ.) Schur's Q-functions and their generalizations

Summary: Schur's Q-functions are a family of symmetric functions introduced by Schur in 1991 in order to describe the characters of irreducible projective representations of symmetric groups. They play a similar role for projective representation to Schur functions (Schur's S-functions) for linear representations of symmetric groups. Later it turns out that Schur's Q-functions appear in various situations parallel to Schur functions.
In this talk, first we review several identities for Schur's Q-functions and provide new transparent proofs to them by using general formulas such as Pfaffian analogues of the Cauchy–Binet formula and the Ishikawa–Wakayama minor-summation formula. Next we introduce and study a generalization of Schur's Q-functions, which includes Ivanov's factorial Q-functions and the $t = -1$ specialization of Hall–Littlewood functions associated with the classical root systems. In the last part, we focus on symplectic Q-functions, which are obtained by putting $t = -1$ in the Hall–Littlewood functions associated to the root system of type C. We establish a tableau description and a Pieri-type rule, and discuss some conjectures including the positivity conjecture of structure constants.

September 24th (Thu)

9:00–12:00

21 Takayuki Hibi (Osaka Univ.)
Kyouko Kimura (Shizuoka Univ.)
Kazunori Matsuda (Kitami Inst. of Tech.)
Adam Van Tuyl (McMaster Univ.)
The regularity and h-polynomial of Cameron–Walker graphs ····· 15

Summary: Fix an integer $n \geq 1$, and consider the set of all connected finite simple graphs on n vertices. For each G in this set, let $I(G)$ denote the edge ideal of G in the polynomial ring $R = K[x_1, \ldots, x_n]$. We initiate a study of the set $\mathcal{RD}(n) \subseteq \mathbb{N}^2$ consisting of all the pairs (r, d) where $r = \mathrm{reg}(R/I(G))$, the Castelnuovo–Mumford regularity, and $d = \deg h_{R/I(G)}(t)$, the degree of the h-polynomial. In particular, we identify sets $A(n)$ and $B(n)$ such that $A(n) \subseteq \mathcal{RD}(n) \subseteq B(n)$. When we restrict to the family of Cameron–Walker graphs on n vertices, we can completely characterize all the possible (r, d).

22 Akiyoshi Tsuchiya (Univ. of Tokyo)
Takayuki Hibi (Osaka Univ.)
Initial ideals and their depth ····· 10

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

23 Hidefumi Ohsugi (Kwansei Gakuin Univ.)
Akiyoshi Tsuchiya (Univ. of Tokyo)
Nef-partitions arising from unimodular configurations ····· 15

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

Summary: For a partition λ of a positive integer n, let I_λ^{Sp} be the ideal of $R = K[x_1, \ldots, x_n]$ generated by all Specht polynomials of shape λ. It is known that if $R/I_\lambda^{\mathrm{Sp}}$ is Cohen–Macaulay then λ is of the form either $(n-d, 1, \ldots, 1), (n-d, d)$, or $(d, d, 1)$, and it is also known that the converse is true if $\mathrm{char}(K) = 0$.
In this talk, we construct minimal free resolutions of $R/I_\lambda^{\mathrm{Sp}}$, when $\mathrm{char}(K) = 0$, and $\lambda = (n-2, 2)$ or $(d, d, 1)$ by using Specht modules and operations on Young diagrams.

Summary: Each subarrangement of the Weyl arrangement of type A, also known as the braid arrangement, is described by using a simple graph. Stanley showed that a combinatorial reciprocity for chromatic symmetric functions of simple graphs with the involution of the ring of symmetric functions. The reciprocity is considered as an Ehrhart-like reciprocity of lattice points of the complement of the corresponding Weyl subarrangements of type A. We generalize Stanley's reciprocity for Weyl subarrangements of type B with signed graphs.

Summary: We give some examples of local rings in relation to weak normality and seminormality in the mixed characteristic case. It is known that two concepts are different in the equal prime characteristic case. We also establish the local Bertini theorem for weak normality in the mixed characteristic case.

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

Summary: We consider a generalization of the torsion theory associated with a Serre subcategory over a commutative Noetherian ring. Aghapournahr and Melkersson defined the Melkersson condition, which is a suitable condition in local cohomology theory. One of our purposes is to show how naturally the concept of Melkersson condition appears in the context of torsion theories.

Summary: It is known that any 3-dimensional quadratic AS-regular algebra is constructed by a unique twisted superpotential up to scalar multiple. In this talk, we give a complete list of twisted superpotentials of 3-dimensional quadratic AS-regular algebras whose point schemes are elliptic curves in $\mathbb{P}^2$.

Summary: Let S be a 3-dimensional quantum polynomial algebra, and $f \in S_2$ a central regular element. The quotient algebra $A = S/(f)$ is called a noncommutative conic. For a noncommutative conic A, there is a finite dimensional algebra $C(A)$ which determines the singularity of A. In this paper, we mainly focus on a noncommutative conic such that its quadratic dual is commutative, which is equivalent to say, S is determined by a symmetric regular superpotential. We classify these noncommutative conics up to isomorphism of the pairs (S, f), and calculate the algebras $C(A)$.

Summary: In dealing with some unsatisfactory features of triangulated categories, differential graded (=DG) categories plays an essential role, which are therefore said to enhance triangulated categories. Motivated by cluster tilting theory, Keller studied when an orbit category of a triangulated category has a triangulated structure. His approach was to take an orbit at an enhancement, which is called a DG orbit category. We will present certain uniqueness of DG orbit categories and give an application to cluster tilting theory.

Summary: In this talk, we first introduce the concept of relative im-summand coinvariancy. Let M and N be modules with the projective covers. M is called *N-im-summand coinvariant* if, for any homomorphism $\varphi : P \to Q$ such that Im φ is a direct summand of Q, $\varphi(\ker p) \subseteq \ker q$, where (P, p) and (Q, q) are the projective covers of M and N, respectively. In addition, we give some fundamental properties of im-summand coinvariant modules, and we show that M is M-im-summand coinvariant if and only if M is quasi-projective for any module M over a right perfect ring.

14:15–14:30 Research Section Assembly

14:30–14:45 Presentation Ceremony for the 2020 MSJ Algebra Prize

14:50–15:50 Award Lecture for the 2020 MSJ Algebra Prize

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

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

16:00–17:00 Award Lecture for the 2020 MSJ Algebra Prize

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

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

September 25th (Fri)

9:50–12:00

Summary: I will have a talk about the classification of Q-Fano 3-folds with codim 4 using Type I unprojection for $f > 2$.

Summary: With a family of toric Calabi–Yau hypersurfaces over a punctured disk, one can associate a logarithmic variation of polarized Hodge structure (LVPH) on the standard log point in two different ways. One is the natural extension to the origin of the residual B-model variation of Hodge structure in the sense of Iritani, and the other is constructed using the radiance obstruction of the integral affine sphere with singularities obtained from the family by tropicalization. In the talk, we show that the resulting LVPHs are isomorphic.

Summary: We give a necessary and sufficient condition for a generalized Bott manifold to be Fano or weak Fano. As a consequence we characterize Fano Bott manifolds.

Summary: We give a classification of toric log del Pezzo surfaces with two or three singular points.

Summary: Let V be a smooth projective rational surface defined over an algebraically closed field and let D be a connected curve on V such that $S = V - D$ contains no (-1)-curves, the logarithmic Kodaira dimension of $S \leq 1$ and $\rho(V) - \#D < 0$, where $\#D$ is the number of the irreducible components of D. In this talk, we show that S contains a surface isomorphic to $\Sigma - C$, where Σ is a Hirzebruch surface and C is a connected curve. Moreover we classify the possible configurations for C.

Summary: The speaker's sufficient criteria for some hierachies, which are stronger than
Higher Uniruledness = Lower Unirationality
is applied to the cases of weighted complete intersections. The resulting sufficient conditions are rather complicated, presumably reflecting the richness of the weighted complete intersections, but are simplified to a very satisfactory single inequality, when restricted to complete intersections.

Summary: Originally, the notion of combinatorial mutations was introduced in the context of mirror symmetry, and the framework of combinatorial mutations was extended. In this talk, we introduce the notion of combinatorial mutation for rational polytopes containing the origin. As an application of combinatorial mutations, we prove that the chain polytope of a poset Π can be obtained by a sequence of the combinatorial mutation from the order polytope of Π. Namely, the order polytope and the chain polytope of the same poset Π are mutation-equivalent.

40 Naoki Fujita (Univ. of Tokyo) Newton–Okounkov bodies of flag varieties and combinatorial mutations
Akihiro Higashitani (Osaka Univ.) 15

Summary: A Newton–Okounkov body is a convex body constructed from a polarized variety with a higher rank valuation on the function field, which gives a systematic method of constructing toric degenerations of polarized varieties. In this talk, we study some kinds of Newton–Okounkov bodies for flag varieties using the framework of combinatorial mutations. By applying iterated combinatorial mutations, we connect specific Newton–Okounkov bodies of flag varieties including string polytopes, Nakashima–Zelevinsky polytopes, and FFLV polytopes.

14:15–16:15

41 Yoshifumi Kato (Meijo Univ.) Curvature matrix of the universal bundle of the Grassmann variety 15

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

42 Yoshifumi Kato (Meijo Univ.) An observation on Schubert polynomials 15

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

43 Yoshifumi Kato (Meijo Univ.) Explicit integral formulas related to flag varieties 15

Summary: We introduce two types of local coordinate system to the flag variety $Fl(n)$ and construct a vector field. Schubert cell is described as the union of flows. The matrix entries of Schubert cell are arranged in a special shape to which we attach a diagram. On the flag variety $Fl(n)$, there exists a flag bundle from which we obtain first Chern classes of line bundles. If we substitute these classes to Schubert polynomials, then their classes become the Poincaré dual of Schubert varieties. In my talk we make explicit forms which represent the Chern classes and show that Shubert polynomials become very simple after substitution and there exist explicit integral formulas.

44 Kotaro Kawatani (Yamato Univ. / Osaka Pref. Univ.) Stability conditions on a principle ideal domain 15

Summary: Let R be a principle ideal domain which is not a field and $D(R)$ the bounded derived category of finitely generated R-modules. We show that there is no stability condition (in the sense of Bridgeland) on $D(R)$. Hence the derived category of affine line $\mathbb{A}^1_k$ over a field k has no stability condition.

45 Koji Nuida (Univ. of Tokyo) An elementary linear-algebraic proof without heavy computation for the group law on elliptic curves 10

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

Summary: For a semi-stable 3-dimensional extremal neighborhood $(X, C) \subset \mathbb{C}^4$ with an irreducible and reduced extremal curve C, the extendability of $\wedge^2(\mathrm{gr}^1_C\Omega^1_X)$ to $\mathrm{gr}^0_C\omega_X$ under LG-deformation of C contributes to the existence of flips for (X, C) [S. Mori, 1988]. Based on this fact, the author reported: (a) an analogue of Miyaoka–Yau type inequality with the associated c_3 on (X, C) [I., 2018/03], and (b) Higgs sheaves associated to (X, C) [I., 2019/09]. Following these results, in this talk, the author will report: for not necessary irreducible nor reduced C, (i) to introduce laminal ideals of C of codimension type 2, with genelazing the one in [S. Mori, 1988]; (ii) to give a deformation of endomorphisms of Higgs sheaves associated to (X, C), as generalizing [Y. Miyaoka, 1987] by (b) and (i), and; (iii) to give an analogue of Miyoaka–Yau type inequality with c_3 associated to extended $S^2(\mathrm{gr}^1_C\Omega^1_X)$ by (a) and (ii).

Summary: As an experiment, we apply our technique via an infinitesimal method to study the degeneration of syzygies for a flat family of canonical curves with genus 5 over a smooth affine curve B. We show that in this example, the structure of the module $\mathscr{T}_3^{1,1}$ detects the transversality of the intersection in the Hilbert scheme $\mathcal{H}$ by the curve B and the analytic local divisor $\mathcal{D}$ corresponding to the trigonal curves.

Geometry

September 22nd (Tue)

10:00–12:00

1 Yuya Takeuchi (Osaka Univ.) A constraint on Chern classes of strictly pseudoconvex CR manifolds 15

Summary: A CR manifold is a real odd-dimensional analog of a complex manifold. In this talk, we give a constraint on Chern classes of strictly pseudoconvex CR manifolds, which are convex in a holomorphic sense. We also see the above result is optimal through some examples.

2 Yuya Takeuchi (Osaka Univ.) Stability of the existence of a pseudo-Einstein contact form 15

Summary: A pseudo-Einstein contact form on a strictly pseudoconvex CR manifold is a contact form satisfying a weak Einstein condition. Recently, the existence of such a contact form has been of great importance since it is necessary for defining some global CR invariants. In this talk, we show that the existence of a pseudo-Einstein contact form is preserved under deformations as a real hypersurface in a complex manifold.

3 Tsukasa Takeuchi (Tokyo Univ. of Sci.) Examples of 4 or 6-dimensional symplectic-Haantjes manifolds and about a relationship with recursion operators 10

Summary: Certain ways of characterizing integrable systems with $(1,1)$-tensor field have been investigated, so far. For example, the construction of recursion operators by G. Marmo, G. Vilasi and more, has been considered, since 1980's. On the other hand, according to P. Tempesta and G. Tondo stablished new method of using $(1,1)$-tensor field for the integrable system, recently. They introduced a concept of symplectic-Haantjes manifolds to treat completely integrable Hamiltonian system by means of the Haantjes tensor and Haantjes operator. We show that a geometrical example of 4 or 6-dimensional symplectic Haantjes manifold and recursion operators. Through these examples, we consider the relationship between recursion operators and Haantjes operators.

4 Koki Matsuzaka (Hokkaido Univ.) Toric construction of moduli space of quasi maps from $\mathbb{P}^1$ with two marked points to $\mathbb{P}^1 \times \mathbb{P}^1$ 10

Summary: In general, a toric variety corresponding to a complete fan can be written by using homogeneous coordinates. This result is due to Cox. On the other hand, the moduli space of quasi maps from $\mathbb{P}^1$ with two marked points to a toric variety V of multi degree which is introduced by Jinzenji is important in mirror symmetry and its compactification is also written by using homogeneous coordinates. In this talk, we give the toric construction of the moduli space of quasi maps in the case of $V = \mathbb{P}^1 \times \mathbb{P}^1$ by using methods of psuedo-fans and the Min-Value Condition (MVC).

5 Kotaro Kawai (Gakushuin Univ.)
Hikaru Yamamoto (Tokyo Univ. of Sci.) Deformation theory of deformed Hermitian Yang–Mills connections and deformed Donaldson–Thomas connections 15

Summary: A deformed Hermitian Yang–Mills (dHYM) connection is a Hermitian connection on a Hermitian line bundle over a Kähler manifold, which is believed to correspond to a special Lagrangian submanifold via mirror symmetry. A deformed Donaldson–Thomas (dDT) connection is its analogue over a G_2-manifold and is believed to correspond to a coassociative submanifold.
The moduli spaces of special Lagrangian submanifolds and coassociative submanifolds are known to be finite dimensional smooth manifolds by McLean. It is natural to ask whether these connections inherit the same properties. We show that each of their deformations is controlled by a subcomplex of an elliptic complex and the moduli space of dHYM connections is always a finite dimensional smooth manifold.

6 Yuichi Ike (Fujitsu Laboratories Ltd.) Tomohiro Asano (Univ. of Tokyo) Microlocal theory of sheaves and displacement energy 15

Summary: We present a sheaf-theoretic method to estimate the displacement energy of compact subsets of a cotangent bundle. In the course of the proof, we introduce an interleaving-like distance on some sheaf category and prove a stability result with respect to Hamiltonian deformation of sheaves. We also give bounds for the displacement energy and the number of intersection points of certain class of rational Lagrangian immersions, based on the purely sheaf-theoretic method.

7 Morimichi Kawasaki (Kyoto Univ.) Ryuma Orita (Niigata Univ.) Pseudoheavy subsets of symplectic manifolds 10

Summary: Displaceability, non-displaceability of subsets of symplectic manifolds is an interesting problem in symplectic geometry from the views of dynamical systems and the mirror symmetry. To approach this problem, Entov and Polterovich defined the heaviness and superheaviness of subsets of symplectic manifolds. To generalize their results and solve their problem, we consider the concept of pseudoheaviness. As its application, we give new examples of non-disolaceable subsets of the product of spheres.

8 Dounnu Sasaki (Waseda Univ.) Denseness property of geodesic currents on a cusped hyperbolic surface 15

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

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

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

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

September 23rd (Wed)

10:00–12:00

9 Takuma Tomihisa (Waseda Univ.), Yasushi Homma (Waseda Univ.) — Spectra of the Rarita–Schwinger operator on some symmetric spaces · · · 10

Summary: We give a method to calculate spectra of the square of the Rarita–Schwinger operator on compact symmetric spaces. According to Weitzenböck formulas, the operator can be written by the Laplace operator, which is the Casimir operator on compact symmetric spaces. Then we can obtain the spectra by using the Freudenthal's formula and branching rules. As examples, we calculate the spectra on the sphere, the complex projective space, and the quaternionic projective space.

10 Akinori Gondo (Hiroshima Univ.) — Weakly reflective homogeneous hypersurfaces in noncompact symmetric spaces · · · 15

Summary: Weakly reflective submanifolds are a class of austere submanifolds with certain global symmetry. In this talk, we give a classification of weakly reflective homogeneous hypersurfaces in noncompact symmetric spaces of low rank. When we approach the classification problem, a necessary condition for a certain type of homogeneous hypersurfaces to be weakly reflective is obtained. Using this condition, we obtain infinitely many examples of austere submanifolds which are not weakly reflective.

11 Masahiro Kawamata (Hiroshima Univ.), Hiroshi Tamaru (Osaka City Univ.) — Left-invariant Ricci soliton metrics on some almost abelian Lie groups · · · 15

Summary: For a given Lie group G, the group $\mathbb{R}^{\times}\mathrm{Aut}(G)$ generated by non-zero scalars and automorphisms of G acts on the space of all left-invariant Riemannian metrics. The orbit space of this action is called the moduli space of left-invariant Riemannian metrics on G. In this talk, for an almost abelian Lie group G whose moduli space is one-dimensional, we prove that a left-invariant Riemannian metric on G is a Ricci soliton if and only if the $\mathbb{R}^{\times}\mathrm{Aut}(G)$-orbit through this metric is an isolated orbit.

12 Hiroshi Sawai (Numazu Nat. Coll. of Tech.) — On the structure theorem for Vaisman solvmanifolds · · · 15

Summary: In locally conformal Kähler geometry (for short LCK), it is said to be Vaisman structure if Lee form is parallel with respect to Levi–Civita connection. In this talk, we consider the structure Theorem for Vaisman solvmanifolds. Moreover, we prove that a Vaisman solvmanifold has no non-Vaisman LCK structure. As a corollary, non-Vaisman LCK solvmanifold has no Vaisman structures. Thus, it is known that Inoue surfaces and Oeljeklaus–Toma manifold are non-Vaisman LCK solvmanifolds, they have no Vaisman structures.

13 Yuji Kondo (Hiroshima Univ.), Hiroshi Tamaru (Osaka City Univ.) — A classification of left-invariant Lorentzian metrics on some nilpotent Lie groups · · · 15

Summary: In this talk, we introduce that there exist exactly six left-invariant Lorentzian metrics on the direct product of three dimensional Heisenberg group and Euclidean space of dimension $n-3$ with $n \geq 4$ up to scaling and automorphisms. Only one of these metrics is flat, and the other five metrics are Ricci soliton but not Einstein. We also characterize the flat metric as the unique closed orbit in terms of the degeneration of orbits. Note that the equivalence class of each left-invariant metric up to scaling and automorphisms can be identified with an orbit of a certain group action on some symmetric space.

14 Yasuki Tada (Hiroshima Univ.) On poles of quandles and quotients of Alexander quandles by poles
Hiroshi Tamaru (Osaka City Univ.) 15

Summary: Quandle is an algebra which has background in Knot theory. Quandles can be regarded as a generalization of symmetric spaces. We study about to redifine various concepts of symmetric spaces on quandle. In this talk, we introduce the concept of "poles" on quandles, by refering to the theory of symmetric spaces. Then one can naturally define the quotients of quandles by poles. Alexander quandle is an important class of quandle. We prove that the class of Alexander quandles is closed under the quotients by poles. We also give a criteria for several Alexander quandles to have non-trivial poles, and determine what their quotients by poles are.

15 Yu Kawakami (Kanazawa Univ.) Heinz-type mean curvature estimates in Lorentz–Minkowski space 15
Atsufumi Honda (Yokohama Nat. Univ.)
Miyuki Koiso (Kyushu Univ.)
Syunsuke Tori (Wajima High School)

Summary: We provide a unified description of Heinz-type mean curvature estimates under an assumption on the gradient bound for space-like graphs and time-like graphs in the Lorentz–Minkowski space. As a corollary, we give a unified vanishing theorem of mean curvature for these entire graphs of constant mean curvature.

13:15–14:15 Award Lecture for the 2020 MSJ Geometry Prize

Mikiya Masuda (Osaka City Univ.)♭ Cohomological rigidity problem in toric topology

Summary: A toric variety is a normal complex algebraic variety with an algebraic action of a C*-torus having an open dense orbit. The fundamental theorem in toric geometry says that there is a one-to-one correspondence between toric varieties and fans. Among toric varieties, compact smooth toric varieties, which we call toric manifolds, are well understood. For instance, their cohomology rings and Chern classes are explicitly described in terms of the associated fans. The classification of toric manifolds as varieties reduces to the classification of the associated fans. However, the classification of toric manifolds as smooth manifolds is not well understood. Related to this, the author and Dong Youp Suh posed the following problem in 2008.
Cohomological rigidity problem (for toric manifolds). Are toric manifolds diffeomorphic (or homeomorphic) if their cohomology rings with integer coefficients are isomorphic as graded rings?
Many partial affirmative solutions to the problem have been obtained but no counterexamples are known so far. There are several analogues of the problem and two of them are a symplectic analogue and a real analogue. The former is related to McDuff's question on the uniqueness of a toric structure on a monotone symplectic manifold and the latter is related to flat Riemannian manifolds and hyperbolic 3-manifolds of Loebell type. In this talk, I will overview some development on these problems.

September 24th (Thu)

9:45–12:00

16 Yusuke Shinoda (Okayama Univ.) On sufficient conditions to extend Huber's finite connectivity theorem
Kei Kondo (Okayama Univ.) to higher dimensions 15

Summary: In this talk we give sufficient conditions to extend Huber's finite connectivity theorem to higher dimensions from the radial curvature geometry point of view.

17 Tadashi Fujioka (Kyoto Univ.) A fibration theorem for collapsing sequences of Alexandrov spaces · · · · 15

Summary: Let a sequence M_j of Alexandrov spaces collapse to an Alexandrov space X where all spaces of directions are δ-close to the unit sphere. We prove that M_j admits a structure of locally trivial fibration over X for sufficiently large j if it has a uniform lower bound $\varepsilon \gg \delta$ on the volume of spaces of directions.

18 Masayuki Aino (RIKEN)$^\flat$ Eigenvalue of Laplacian and Gromov–Hausdorff convergence to the product of spheres · 15

Summary: Lichnerowicz–Obata theorem is one of the classical theorem about the first eigenvalue of the Laplacian on Riemannian manifolds. Lichnerowicz gave an estimate of the first eigenvalue of the Laplacian for the Riemannian manifold with positive Ricci curvature, and Obata showed the equality of the estimate characterizes the sphere. Moreover, the almost equality case is well studied, and it is known that the manifold is close to the sphere in the Gromov–Hausdorff sense under some conditions. In this talk, we give a Gromov–Hausdorff approximation to the product of spheres under some conditions.

19 Takumi Gomyou (Nagoya Univ.)
Toshimasa Kobayashi (Setsunan Univ.)
Takefumi Kondo (Kagoshima Univ.)
Shin Nayatani (Nagoya Univ.)
Optimal embedding and maximization of the first eigenvalue of a finite graph · 15

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

20 Taiki Yamada (Res. Inst. for Humanity and Nature) The lower bound of the eigenvalue of the Laplacian on simplicial complex by the Ricci curvature · 15

Summary: The Ricci curvature on graphs plays an important role in discrete differential geometry when we research global properties of a graph. We define the Ricci curvature on simplicial complexes modifying the definition of the Ricci curvature on graphs. Using the i-Laplacian defined by Horak and Jost, we obtain the following main results. It is an estimate of the eigenvalues of the Laplacian on simplicial complexes by the Ricci curvature.

21 Tetsu Toyoda (Kogakuin Univ.) A non-geodesic analogue of Reshetnyak's majorization theorem · · · · · · 15

Summary: Let κ be a real number. Gromov (2001) introduced the $\mathrm{Cycl}_n(\kappa)$ conditions for all integers $n \geq 4$, each of which is a necessary condition for a metric space to admit an isometric embedding into a $\mathrm{CAT}(\kappa)$ space. We prove an analogue of Reshetnyak's majorization theorem for (possibly non-geodesic) metric spaces that satisfy the $\mathrm{Cycl}_4(\kappa)$ condition. It follows from our result that for general metric spaces, the $\mathrm{Cycl}_4(\kappa)$ condition implies the $\mathrm{Cycl}_n(\kappa)$ conditions for all integers $n \geq 5$.

22 Motoko Kato (Ehime Univ.)
Shin-ichi Oguni (Ehime Univ.)
On acylindrical hyperbolicity of some Artin groups · · · · · · · · · · · · · · · · · 15

Summary: It is conjectured that the central quotient of every irreducible Artin group is either virtually cyclic or acylindrically hyperbolic. We prove this conjecture for Artin groups that are known to be CAT(0) groups by a result of Brady and McCammond. In particular, we treat Artin groups associated to triangle-free graphs and Artin groups of large type associated to cones over square-free bipartite graphs.

Summary: We provide an interpolation theorem of a family of metrics defined on closed subsets of metrizable spaces. As an application, we observe that various sets of all metrics with properties appeared in metric geometry are dense intersections of countable open subsets in spaces of metrics on metrizable spaces. For instance, our study is applicable to the set of all non-doubling metrics and the set of all non-uniformly disconnected metrics.

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

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

Summary: The complex moduli space of a Calabi–Yau manifold carries a natural Kähler structure, called the Weil–Petersson geometry, and this has been an important tool in the study of Calabi–Yau manifolds. Inspired by mirror symmetry, we introduce the mirror Weil–Petersson geometry on the Kähler moduli space. The main tool is the stability conditions of a triangulated category introduced by T. Bridgeland. As an application, we investigate the attractor mechanisms of the Kähler moduli space, the mirror of which on the complex moduli space was previously studied by G. Moore.

Complex Analysis

September 22nd (Tue)

9:00–10:30

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

Summary: This abstract is an arranged version of the 2020 annual meeting talk. In this talk, we will note a simple and pleasant new property that an Okumura's disc series can beyond the crucial point of Däumler and Puha's horn torus models for the Riemann sphere by means of the division by zero calculus. We also will refer to the up to date information on the division by zero calculus.
Key Words: Infinity, discontinuous, point at infinity, stereographic projection, Riemann sphere, horn torus, Däumler Puha's horn torus, Okumura's disc series, conformal mapping, division by zero calculus.

2 Hiroki Fujino (Nagoya Univ.) Shintaro Akamine (Nihon Univ.) Correspondence between boundary value problems for harmonic mappings, minimal surfaces, and maximal surfaces 15

Summary: There exists a natural correspondence between (planar) univalent harmonic mappings, minimal surfaces in the Euclidean space, and maximal surfaces in the Lorentz–Minkowski spacetime. Under this correspondence, we found that some kinds of important boundary value problems for each of these three objects correspond to each other: (a) infinite boundary for minimal surfaces, (b) lightlike line segment boundary for maximal surfaces, and (c) discontinuous boundary value for harmonic mappings. We also discuss symmetries appearing on the above kinds of surfaces and their conjugations.

3 Gou Nakamura (Aichi Inst. of Tech.)♭ Automorphism groups of compact non-orientable surfaces of genus 6 with extremal metric discs 15

Summary: In this talk we present the groups of automorphisms of non-orientable extremal surfaces of genus 6. Considering those surfaces with automorphisms of the maximum order 10, we obtain two families of non-orientable extremal surfaces of even genus g admitting automorphisms of the maximum order $2(g-1)$.

4 Ege Fujikawa (Tokyo Tech)♭ Asymptotically conformal invariance of the essential length spectrum on a Riemann surface 15

Summary: The length spectrum is the set of hyperbolic lengths of closed geodesics on a Riemann surface. In this talk, we introduce the essential length spectrum on a Riemann surface of topologically infinite type, which is the set of accumulation points on the length spectrum of the Riemann surface. Then, we prove that this is invariant under the deformation of asymptotically conformal homeomorphisms of Riemann surfaces.

5 Katsuhiko Matsuzaki (Waseda Univ.) Huaying Wei (Jiangsu Normal Univ.) Strongly symmetric homeomorphisms on the real line with uniform continuity 15

Summary: We consider certain properties of strongly symmetric homeomorphisms on the real line, which constitute the VMO Teichmüller space on it. Differently from the case on the unit circle, strongly symmetric homeomorphisms are not preserved under either the composition or the inversion. They are not known to have quasiconformal extensions whose complex dilatations induce vanishing Carleson measures, either. In this presentation, however, we show that if uniform continuity is assumed for appropriate mappings, then they are preserved by those operations and they have such quasiconformal extensions. Proofs are performed by using harmonic analysis on BMO functions and the Muckenhoupt weights.

6 Takayuki Watanabe (Kyoto Univ.)
Hiroki Sumi (Kyoto Univ.)
The dichotomy of Markov random dynamical systems of rational maps 15

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

11:00–12:00 Award Lecture for the 2019 MSJ Analysis Prize

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

Summary: We consider random holomorphic dynamical systems. We see that there are many new phenomena, so called randomness-induced phenomena, in random holomorphic dynamical systems which cannot hold in determinstic holomorphic dynamical systems. We also consider the mechanisms of the phenomena and some applications.

14:15–15:55

7 Takanori Ayano (Osaka City Univ.)
Victor M. Buchstaber (Steklov Inst. of Math.)
A refinement for the Hurwitz integrality of the series expansion of the two-dimensional sigma functions 15

Summary: F. Klein constructed the multi-dimensional sigma functions associated with the hyperelliptic curves as a generalization of the elliptic sigma functions. The hyperelliptic sigma functions play important roles in the inversion problem of the hyperelliptic integrals. Y. Onishi proved that the series expansion of the hyperelliptic sigma functions around the origin becomes the Hurwitz series over the ring generated by the parameters of the curves. In this talk, we will give a refinement of this result for the case of genus 2. Our result is based on the fact that the two-dimensional sigma functions satisfy the heat equations in a nonholonomic frame, which is derived by V. M. Buchstaber and D. V. Leykin.

8 Makoto Abe (Hiroshima Univ.)
Tadashi Shima (Hiroshima Univ.)
Shun Sugiyama (NEC Comm. Systems, Ltd.)
Intermediate pseudoconvexity for unramified Riemann domains over $\mathbb{C}^n$ 10

Summary: We characterize the q-pseudoconvexity for unramified Riemann domains over $\mathbb{C}^n$, where $1 \leq q \leq n$, by the continuity property which holds for a class of maps whose projections to $\mathbb{C}^n$ are families of unidirectionally parameterized q-dimensional analytic balls written by polynomials of degree at most two.

9 Yuta Kusakabe (Osaka Univ.)$^{\flat}$
Oka properties of complements of polynomially convex sets 15

Summary: A complex manifold is called an Oka manifold if the Oka principle for maps from Stein manifolds holds. Our main theorem states that the complement of a closed polynomially convex set in $\mathbb{C}^n$ $(n > 1)$ satisfying a certain condition is an Oka manifold. This gives a positive answer to the well-known long-standing problem in Oka theory whether the complement of a compact polynomially convex set in $\mathbb{C}^n$ $(n > 1)$ is Oka.

10 Masataka Iwai (Osaka City Univ.)
Sho Ejiri (Osaka Univ.)
Shin-ichi Matsumura (Tohoku Univ.)
On asymptotic base loci of relative anti-canonical divisors 15

Summary: We study the base loci including the stable (augmented, restricted) base loci and upper level sets of Lelong numbers of the relative anti-canonical divisor $-K_{X/Y}$ of an algebraic fiber space $\phi : X \to Y$. Our result says that all the above base loci are located in the horizontal direction unless they are empty.

11 Shinichi Tajima (Niigata Univ.*) Katsusuke Nabeshima (Tokushima Univ.) — Computing regular meromorphic differential forms via Saito's logarithmic residues · · · · · 15

Summary: We consider logarithmic differential forms along a hypersurface with an isolated singularity in the context of computational complex analysis. In our previous work, we study torsion modules and give an effective method for computing them. In this work, we first consider a method for computing regular meromorphic differential forms. We show that representatives of regular meromorphic differential forms can be computed by using our previous algorithm on torsion modules. Main ideas of our approach are the use of the concept of logarithmic residue and that of logarithmic vector field. Next, we show a link between logarithmic differential forms and Gauss–Manin connections, which reveals the role of the torsion module in the computation of a saturation of Brieskorn lattice of Gauss–Manin connection.

12 Shinichi Tajima (Niigata Univ.*) Katsusuke Nabeshima (Tokushima Univ.) — An implementation of the Suwa method for computing versal unfoldings of codimension one complex analytic singular foliations · · · · · 15

Summary: The Suwa method for computing versal unfoldings of holomorphic singular foliations is studied from the point of view of computational complex analysis. Based on the theory of Grothendieck local duality on residues, an effective algorithm of computing versal unfoldings of codimension one complex analytic singular foliations is obtained.

13 Katsunori Iwasaki (Hokkaido Univ.) Yuta Takada (Hokkaido Univ.) — From hypergeometric groups to Siegel disks on K3 surfaces · · · · · 15

Summary: C. T. McMullen constructed K3 surface automorphisms with Siegel disks. The topological entropies of them must be positive and the underlying K3 surfaces must be transcendental. In this talk we propose a completely different method to construct such automorphisms by using hypergeometric groups and associated lattices. Here hypergeometric groups, due to F. Beukers and G. J. Heckman, are matrix groups modeled on the monodromy groups of higher-order hypergeometric differential equations.

16:00–17:00 Talk Invited by Complex Analysis Section

Yohei Komori (Waseda Univ.) — On the growth rate of hyperbolic Coxeter groups

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

September 23rd (Wed)

9:00–10:20

14 Tatsuhiro Honda (Senshu Univ.) Hidetaka Hamada (Kyushu Sangyo Univ.) Yusuke Mizota (Kyushu Sangyo Univ.) — Bohr's phenomenon on a complex Banach space · · · · · 15

Summary: In this talk, we discuss about generalisations of the Bohr radius for analytic functions or harmonic functions on the unit disc in $\mathbb{C}$ to that for holomorphic mappings or pluriharmonic mappings on the unit ball of a complex Banach space.

15 Ian Graham (Univ. of Toronto) Hidetaka Hamada (Kyushu Sangyo Univ.) Gabriela Kohr (Babeş-Bolyai Univ.) — Loewner chains and nonlinear resolvents of the Carathéodory family on the unit ball in $\mathbb{C}^n$ · · · · · 15

Summary: In this talk, we study various properties of nonlinear resolvents of holomorphic mappings in the Carathéodory family $\mathcal{M}(\mathbb{B}^n)$, where $\mathbb{B}^n$ is the Euclidean unit ball in $\mathbb{C}^n$.

Summary: In this talk, we will show that $\Phi_{\alpha,\beta}$ and Φ_{P_k} preserves the first elements of g-Loewner chains and normalized Bloch mappings, where $\Phi_{\alpha,\beta} : S \to S(\Omega_r)$ is the Roper–Suffridge type extension operator and Φ_{P_k} is the Muir type extension operator.

Summary: In this talk, we study some extremal problems for the family $S_g^0(\mathbb{B}_X)$ of normalized univalent mappings with g-parametric representation on the unit ball $\mathbb{B}_X$ of an n-dimensional JB*-triple X with $r \geq 2$, where r is the rank of X and g is a convex (univalent) function on the unit disc $\mathbb{U}$, which satisfies some natural assumptions. We obtain sharp coefficient bounds for the family $S_g^0(\mathbb{B}_X)$, and examples of bounded support points for various subsets of $S_g^0(\mathbb{B}_X)$. Our results are generalizations to bounded symmetric domains of known recent results related to support points for families of univalent mappings on the Euclidean unit ball $\mathbb{B}^n$ and the unit polydisc $\mathbb{U}^n$ in $\mathbb{C}^n$.

Summary: Let $\mathbb{B}_X$ and $\mathbb{B}_Y$ be bounded symmetric domains realized as the unit balls of JB*-triples X and Y, respectively. In this talk, we generalize the Landau theorem to holomorphic mappings on $\mathbb{B}_X$ by using the Schwarz–Pick lemma for holomorphic mappings on $\mathbb{B}_X$. Next, we give several necessary conditions or sufficient conditions for the composition operators C_φ between the Bloch spaces on $\mathbb{B}_X$ and $\mathbb{B}_Y$ to be bounded below.

Summary: Let $n \geq 2$ and let $A \in L(\mathbb{C}^n)$ be such that $m(A) > 0$. In this talk, we show that if $F : \mathbb{B}^n \to \mathbb{C}^n$ is a normalized biholomorphic mapping such that $F(\mathbb{B}^n)$ is a bounded strictly pseudoconvex domain with C^m boundary with $m > 2$, then $\overline{F(\mathbb{B}^n)}$ is polynomially convex if and only if there exists a normalized automorphism $\Phi : \mathbb{C}^n \to \mathbb{C}^n$ such that $\Phi(F(\mathbb{B}^n))$ is an A-spirallike domain. This result extends a recent result due to Arosio, Bracci and Wold in the case of convexshapelike domains.

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

Shin-ichi Matsumura (Tohoku Univ.)[♭] Structure theorems on projective manifolds with non-negative curvature

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

Functional Equations

September 22nd (Tue)

9:30–11:30

1 Hiroto Inoue (Kyushu Univ.) Matrix-valued Bratu equation associated with the symmetric domain of type BD I ····· 15

Summary: The Bratu equation is an integrable ordinary equation, that appears as a special case of the Toda lattice and the Painlevé III equation. In this talk, we introduce a matrix-valued extension of the Bratu equation. This extension is based on the geometric structure of a symmetric domain G/K. As a main result, we give its exact solution using the defining function of the symmetric domain. In the talk, we mostly consider the case of the symmetric domain of type BD I.

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

Summary: In the last time, we present an initial value problem for a system of first-order partial differential equations in two variables and explain the relationship with entire functions of Hermite–Biehler class. In this time, we will describe additional issues together with some simple examples.

3 Atsuhide Ishida (Tokyo Univ. of Sci.) On minimal velocity estimate in fractional relativistic mechanics ····· 10

Summary: In scattering theory, the propagation estimate for the low velocity state plays a conclusive role to prove the asymptotic completeness of the wave operators. In this study, we prove the minimal velocity estimate for the massive relativistic Schrödinger operator with fractional powers. In particular, we allow to assume that the potential functions belong to the broad classes which include the long-range and Coulomb-type singularities. By virtue of this estimate, the asymptotic completeness for the short-range case can be proved immediately. This estimate can also be expected to work for further applications (long-range and N-body).

4 Hiroyuki Usami (Gifu Univ.)
Luey Sokea (Gifu Univ.) Asymptotic forms of solutions of perturbed half-linear equations ····· 15

Summary: We consider asymptotic forms of every nontrivial solutions of a class of half-linear ordinary differential equations. When these equations reduce to linear equations, it is well known that every nontrivial solution of them behaves like exponential functions. We will show that this property is still valid even for general half-linear equations under a smallness condition on the perturbation.

5 Tetsutaro Shibata (Hiroshima Univ.) Asymptotic expansion of oscillatory bifurcation curves of ODEs with nonlinear diffusion ····· 15

Summary: We consider the global behavior of bifurcation diagrams of nonlinear ODEs with nonlinear diffusion, in which some oscillatory nonlinearities are included. In our situation, the bifurcation parameter λ is a continuous function of the maximum norm $\alpha = \|u_\lambda\|_\infty$ of the solution u_λ, which is associated with λ, and is expressed as $\lambda = \lambda(\alpha)$. In this talk, the case where $\lambda(\alpha) \to \pi^2$, $\lambda(\alpha) \to 0$ and $\lambda(\alpha) \to \infty$ as $\alpha \to \infty$ are treated. In the main theorem, several asymptotic formulas for $\lambda(\alpha)$ as $\alpha \to \infty$ with the exact second and third terms are given.

6 Ryuji Kajikiya (Saga Univ.) Existence of symmetric and asymmetric nodal solutions for the Moore–Nehari equation. ····· 15

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

7 Tatsuki Mori (Musashino Univ.)
Kousuke Kuto (Waseda Univ.)
Tohru tsujikawa (Meiji Univ.)
Shoji Yotsutani (Ryukoku Univ.*)
On the secondary bifurcation curves of a nonlocal Allen–Cahn–Nagumo equation 10

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

14:15–16:15

8 Toshio Horiuchi (Ibaraki Univ.)
Hardy's inequalities with non-doubling weights and sharp remainders 15

Summary: In this talk we shall establish n dimensional weighted Hardy inequalities with non-doubling weight functions of the distance function $\delta(x)$ to the boundary $\partial\Omega$, where Ω is a C^2 class bounded domain of $\mathbb{R}^n$ $(n \geq 1)$. This work is essentially based on one dimensional weighted Hardy inequalities with one-sided boundary condition which have sharp remainders. As weights we adopt that may vanish or blow up in infinite order such as $e^{-1/t}$ and $e^{1/t}$ at $t = 0$.

9 Naoki Hamamoto (Osaka City Univ.)
Futoshi Takahashi (Osaka City Univ.)
The best constant in Rellich–Hardy inequality for curl-free fields 12

Summary: We report on the Rellich–Hardy inequality with sharp constant for curl-free vector fields. This inequality serves as an intermediate between the sharp Hardy– and Rellich–Leray inequalities for curl-free fields, which we found in our previous work on the higher-dimensional and curl-free generalization of the two-dimensional case of Costin–Maz'ya's result.

10 Takanobu Hara (Hokkaido Univ.)
Quasilinear elliptic equations with sub-natural growth terms in bounded domains 10

Summary: We consider the existence of positive solutions to weighted quasilinear elliptic differential equations of the type

$$\begin{cases} -\Delta_{p,w} u = \sigma u^q & \text{in } \Omega, \\ u = 0 & \text{on } \partial\Omega \end{cases}$$

in the sub-natural growth case $0 < q < p - 1$, where Ω is a bounded domain in $\mathbb{R}^n$, $\Delta_{p,w}$ is a weighted p-Laplacian, and σ is a Radon measure on Ω. We give criteria for the existence problem. For the proof, we investigate various properties of p-superharmonic functions, especially solvability of Dirichlet problems with non-finite measure data.

11 Alessio Pomponio (Politecnico di Bari)
Tatsuya Watanabe (Kyoto Sangyo Univ.)
Ground state solutions for quasilinear scalar field equations arising in nonlinear optics 15

Summary: In this talk, we study a class of quasilinear elliptic equations which appears in nonlinear optics. By using the mountain pass theorem together with a technique of adding one dimension of space, we prove the existence of a non-trivial weak solution for general nonlinear terms of Berestycki–Lions' type. The existence of a ground state solution is also established under stronger assumptions on the quasilinear term.

12 Yohei Sato (Saitama Univ.)
Masataka Shibata (Tokyo Tech)
Nonlinear scalar field equations with Berestycki–Lions' nonlinearity on large domains 15

Summary: We consider the existence of solutions to $-\Delta u = g(u)$ in Ω, $u \in H_0^1(\Omega)$, where Ω is a suitable large bounded domain and g satisfies the same conditions as Berestycki–Lions' conditions. Those conditions of g are known as "almost sufficient and necessary conditions" for the existence of nontrivial solutions to the equations defined in $\mathbb{R}^N$. The main difficulty to prove the existence of solutions for the bounded domain case is how to obtain bounded Palais–Smale sequences. To overcome this difficulty, we introduce a modified functional.

13 Yasuhiro Fujita (Univ. of Toyama)
Nao Hamamuki (Hokkaido Univ.)
Norikazu Yanaguchi (Univ. of Toyama)
Propagation of singularities in a Hamilton–Jacobi equation with the initial data of the Takagi function 15

Summary: We consider the solution to a Hamilton–Jacobi equation with the initial data of the Takagi function, which is everywhere continuous and nowhere differentiable. We clarify how singularities of the solution propagate along generalized characteristics.

14 Kazuhiro Takimoto (Hiroshima Univ.)
Bernstein type theorem for the parabolic 2-Hessian equation under weaker conditions 15

Summary: In this talk, we deal with the characterization of entire solutions to the parabolic 2-Hessian equation of the form $u_t = \mu(F_k(D^2u)^{1/2})$ in $\mathbb{R}^n \times (-\infty, 0]$. We prove that any strictly 2-convex-monotone solution $u = u(x,t) \in C^{4,2}(\mathbb{R}^n \times (-\infty, 0])$ must be a linear function of t and a quadratic polynomial of x, under some assumptions on $\mu : (0,\infty) \to \mathbb{R}$, some growth conditions on u and the boundedness of 3-Hessian of u from below.

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

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

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

September 23rd (Wed)

9:30–11:30

15 Ryu Fujiwara (Meiji Univ.)
Existence of discontinuous stationary solutions of a nonlocal Allen–Cahn equation 15

Summary: We consider stationary solutions of a nonlocal Allen–Cahn equation whose diffusion term is defined by using a positive valued integral kernel. We prove that there exist discontinuous stationary solutions if the diffusion coefficient is sufficiently small. Our result partially extends that of Bates et al., who proved that there exist discontinuous stationary solutions of a nonlocal Allen–Cahn equation using convolution as its diffusion term.

16 Yuta Ishii (Tokyo Metro. Univ.)
Kazuhiro Kurata (Tokyo Metro. Univ.)
Existence of multi-peak stationary solutions to the Schnakenberg model on metric graphs 15

Summary: In this talk, we consider the existence of one-peak and two-peak stationary solutions of the Schnakenberg model with heterogeneity on compact metric graphs. In the one-dimensional interval and non-heterogeneity case, Iron, Wei, and Winter investigated the existence of these solution with symmetry and their stability. By using our abstract theorem, we investigate the existence of one-peak solutions and two-peak solutions with the same heights of the spikes in the non-heterogeneity case. Moreover, we compare our results with the results of Wei et al., and reveal the effect of the geometry of the Y-shaped graph to the location of concentration points. This is a joint work with Prof. Kazuhiro Kurata.

17 Yuta Ishii (Tokyo Metro. Univ.) Stability analysis of multi-peak stationary solutions to the Schnakenberg model on metric graphs ····· 15

Summary: In this talk, we consider one-peak and two-peak stationary solutions of the Schnakenberg model with heterogeneity on compact metric graphs. We can give the abstract theorem on the stability of these solutions for general compact metric graphs under the several assumptions. However, for simplicity, we concentrate on the Y-shaped metric graph and non-heterogeneity case. The existence of these solutions for general graphs was established by Ishii and Kurata. We establish the stability of these solutions and reveal the effect of the geometry of the Y-shaped graph to the stability.

18 Yasuhito Miyamoto (Univ. of Tokyo) A doubly critical semilinear heat equation in the L^1 space ····· 10

Summary: We study the existence and nonexistence of a Cauchy problem of the semilinear heat equation in $L^1(\mathbb{R}^N)$: $\partial_t u = \Delta u + |u|^{p-1}u$ in $\mathbb{R}^N \times (0,T)$ and $u(x,0) = \phi(x)$ in $\mathbb{R}^N$. Here, $N \geq 1$, $p = 1 + 2/N$ and $\phi \in L^1(\mathbb{R}^N)$ is a possibly sign-changing initial function. Since $N(p-1)/2 = 1$, the L^1 space is scale critical and this problem is known as a doubly critical case. It is known that a solution does not necessarily exist for every $\phi \in L^1(\mathbb{R}^N)$. In this paper we construct a local-in-time mild solution in $L^1(\mathbb{R}^N)$ for a certain ϕ. We show that there is a nonnegative initial function ϕ_0 such that the problem has no nonnegative solution. We also prove a uniqueness in a certain set of functions which guarantees the uniqueness of the solution constructed by our method.

19 Marius Ghergu (UCD) Radial single point rupture solutions for a general MEMS model ····· 10
Yasuhito Miyamoto (Univ. of Tokyo)

Summary: We study the initial value problem: $r^{-(\gamma-1)}\left(r^{\alpha}|u'|^{\beta-1}u'\right)' = \frac{1}{f(u)}$ for $0 < r < r_0$, $u(r) > 0$ for $0 < r < r_0$ and $u(0) = 0$. Here, $\gamma > \alpha > \beta \geq 1$, $f \in C[0,\bar{u}) \cap C^2(0,\bar{u})$, $f(0) = 0$, $f(u) > 0$ on $(0,\bar{u})$ and f satisfies certain assumptions which include the standard case of pure power nonlinearities encountered in the study of Micro-Electromechanical Systems (MEMS). We obtain the existence and uniqueness of a solution u^* to the above problem, the rate at which it approaches the value zero at the origin and the intersection number of points with the corresponding regular solutions $u(\,\cdot\,,a)$ (with $u(0,a) = a$) as $a \to 0$. In particular, these results yield the uniqueness of a radial single point rupture solution and other qualitative properties for MEMS models. The bifurcation diagram is also investigated.

20 Asato Mukai (Univ. of Tokyo) Refined construction of type II blow-up solutions for a semilinear heat
Yukihiro Seki (Osaka City Univ.) equation with Joseph–Lundgren supercritical nonlinearity ····· 12

Summary: We are concerned with blow-up mechanisms in a heat equation space-dependent nonlinearity:

$$u_t = \Delta u + |x|^{2a}u^p, \qquad x \in \mathbf{R}^N,\ t > 0,$$

where $p > 1$, $a > -1$ are constants. In the case $a = 0$, a well-known result due to M. A. Herrero and J. J. L. Velázquez, C. R. Acad. Sci. Paris Sér. I Math. (1994), states that if $N \geq 11$ and $p > p_{JL} := 1 + 4/(N - 4 - 2\sqrt{N-1})$, then there exist radial Type II blow-up solutions. We revisit the idea of their construction and obtain refined estimates for such solutions using the technique developed in recent works as well as improved arguments on the estimate of the heat semigroup in backward similarity variable.

21 Isamu Ohnishi (Hiroshima Univ.) Characterization to behavior of solutions in semi-linear parabolic PDEs with a certain additional term ····· 15

Summary: A certain class of semi-linear parabolic PDE with an additional term has been studied here. This sometimes has a kind of optimal shape of solution, and it is characterized by some mathematical point of views of PDE. Today, I will report one of basic validity of foundation of these characterizations by the point of view of technique of evolution equation theory about its optimality.

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

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

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

September 24th (Thu)

9:30–11:30

22 Jumpei Inoue (Waseda Univ.)
Kousuke Kuto (Waseda Univ.)
On the optimal distribution and the existence of an L^1-unbounded sequence of steady states for the diffusive logistic equation 15

Summary: We discuss a stationary diffusive logistic equation on a ball. This talk focuses on an open question that showing the upper bound of the ratio of a total population to total resources. In one-dimensional case, Bai–He–Li (2016) settled that the supremum is equal to 3 by finding a special sequence of diffusion coefficients and carrying functions, and moreover, the first speaker recently obtained profiles of solutions corresponding to the maximizing sequence. A new question is the following: What happens in higher-dimensional cases? This talk shows that the supremum is infinite on the spherical symmetry domain.

23 Yoshie Sugiyama (Osaka Univ.)
Masanari Miura (Yamato Univ.)
Seungwon Jeong (Seoul Nat. Univ.)
On Hölder continuity of solutions to non-linear diffusion equation with derivative external forces 15

Summary: We consider the non-linear diffusion equation with derivative external forces. The purpose of our talk is to show the Hölder continuity of solutions to the initial value problem of such an equation.

24 Yutaro Chiyo (Tokyo Univ. of Sci.)
Masaaki Mizukami (Tokyo Univ. of Sci.)
Tomomi Yokota (Tokyo Univ. of Sci.)
Does the repulsion term really derive boundedness in a chemotaxis system? 15

Summary: This talk deals with a fully parabolic attraction-repulsion chemotaxis system (1) with signal-dependent sensitivities and logistic source. The case of constant sensitivities without logistic dampening was studied by Tao–Wang (2013) under some condition in the two-dimensional setting. The purpose of this talk is to show global existence and boundedness of classical solutions to the system (1) under several conditions.

25 Sachiko Ishida (Chiba Univ.)
Tomomi Yokota (Tokyo Univ. of Sci.)
Stabilization of weak solution to parabolic equations with L^1-conservation law. 15

Summary: We consider the initial-boundary value problem for the parabolic equations in divergence form in a smooth bounded domain under the no-flux boundary condition. In particular, for the problem with degenerate diffusion, it is known that there exists a global-in-time weak solution by the well-known parabolic theory. We will show that this problem possesses a globally bounded weak solution which approaches a steady state in the large time limit.

26 Takayoshi Ogawa (Tohoku Univ.)
Masaki Kurokiba (Muroran Inst. of Tech.)
Zero relaxation limit for the Keller–Segel equation to the drift-diffusion system · · · · · 15

Summary: We consider the zero-relaxation limit for the Cauchy problem of the Keller–Segel equations and show the solution converges to the solution of the corresponding drift-diffusion system for all dimension $n \geq 3$. The proof is relies on generalized maximal regularity for the Cauchy problem of the heat equations and the strong limit in the Bochner–Lebesgue space with the scaling critical exponent is shown.

27 Yuya Tanaka (Tokyo Univ. of Sci.)
Tomomi Yokota (Tokyo Univ. of Sci.)
Does blow-up occur in a Keller–Segel system not only with logistic source but also with weak chemotactic sensitivity? · · · · · 15

Summary: This talk deals with blow-up of solutions to a parabolic–elliptic Keller–Segel system with logistic source and weak chemotactic sensitivity. In a special setting Winkler (2018) found the conditions such that solutions blow up in finite time. The purpose of this talk is to give conditions such that there are solutions which blow up in finite time in the case of weak chemotactic sensitivity.

28 Kentarou Fujie (Tohoku Univ.)
Jie Jiang (WIPM)
Comparison methods for a Keller–Segel-type model · · · · · 10

Summary: This talk is concerned with global well-posedness to some chemotaxis system, which was recently proposed to describe the process of stripe pattern formations via the self-trapping mechanism. In particular, we consider the case that the motility function is decreasing exponentially. This system shares the same set of equilibria as well as the Lyapunov functional as the Keller–Segel model. In the two-dimensional setting, we observe a critical-mass phenomenon which is distinct from the well-known fact for the Keller–Segel model. We prove that the classical solution always exists globally, which remains uniformly-in-time bounded with arbitrary initial data of subcritical mass. On the contrary, with certain initial data of supercritical mass, the solution will become unbounded at time infinity.

14:15–16:15

29 Masamitsu Suzuki (Univ. of Tokyo)
Local existence and nonexistence for fractional in time weakly coupled reaction-diffusion systems · · · · · 10

Summary: Let $0 < \alpha < 1$ and $T > 0$. We study the fractional in time weakly coupled reaction-diffusion system

$$\begin{cases} \partial_t^\alpha u = \Delta u + f_1(x,t,v) & \text{in } \Omega \times (0,T), \\ \partial_t^\alpha v = \Delta v + f_2(x,t,u) & \text{in } \Omega \times (0,T), \\ u(x,t) = v(x,t) = 0 & \text{on } \partial\Omega \times (0,T), \\ u(x,0) = u_0(x), v(x,0) = v_0(x) & \text{in } \Omega, \end{cases}$$

where ∂_t^α is in the sense of Caputo, and $\Omega \subset \mathbb{R}^N$, $N \geq 1$, is a bounded domain with C^2 boundary. We consider the case where f_1 and f_2 polynomially grow with respect to v and u, respectively. We obtain integrability conditions of (u_0, v_0) which determine the existence/nonexistence of a local in time solution.

30 Tsukasa Iwabuchi (Tohoku Univ.)
Analyticity and large time behavior for the Burgers equation with the critical dissipation · · · · · 10

Summary: We study the Cauchy problem of the Burgers equation with the critical dissipation. The solvability and the global in time regularity are known results. In this talk, we show the following. The first result is the analyticity in space and time. The second result is the large time behavior of the solution without any smallness condition on initial data.

31 Noboru Chikami (Nagoya Inst. of Tech.) Masahiro Ikeda (RIKEN/Keio Univ.) Koichi Taniguchi (Nagoya Univ.) Behavior of solutions to the energy critical Hardy–Hénon parabolic equation 10

Summary: We consider the Cauchy problem for energy critical Hardy–Hénon parabolic equation. Our purpose is to give a necessary and sufficient condition on the initial data below the ground state under which the local solution in time can be extended globally and its energy decays to zero or it blows up in finite or infinite time. The proof of dissipation part is based on a concentration compactness, a perturbative result, and a rigidity theorem taking into account existence of the Hardy potential. Especially, our method does not need backward uniqueness. The proof of blow up part reduces to an argument to an ordinary differential inequality for a functional of the localized solution.

32 Yoshinori Nishii (Osaka Univ.) Hideaki Sunagawa (Osaka City Univ.) Hiroki Terashita Energy decay for small solutions to semilinear wave equations with weakly dissipative structure 12

Summary: In this talk, we present an energy decay result for small data solutions to a class of semilinear wave equations in two space dimensions possessing weakly dissipative structure relevant to the Agemi condition.

33 Yusuke Sugiyama (Univ. of Shiga Pref.) Finite time blow-up for parameterized 1D quasilinear wave equations 10

Summary: We consider the blow-up of solutions to the following parameterized nonlinear wave equation: $u_{tt} = c(u)^2 u_{xx} + \lambda c(u)c'(u)(u_x)^2$ with the parameter $\lambda \in (0, 2]$. If $\lambda = 1$ and 2, it is known that there exist finite time blow-up solutions. However, the construction of blow-up solution heavily depends on the structure of the equation (e.g. the energy conservation law). In this talk, we extend the blow-up result with $\lambda = 1$ to the case with $\lambda \in (0, 1]$ by using a new $L^{\lambda/2}$ estimate.

34 Mamoru Okamoto (Osaka Univ.) Justin Forlano (Heriot-Watt Univ.) On the ill-posedness of the Cauchy problem for the nonlinear wave equation 10

Summary: We consider the Cauchy problem for the nonlinear wave equation. By using a Fourier analytic approach, we prove that the nonlinear wave equations experience norm inflation in negative Sobolev spaces. In particular, we obtain the ill-posedness above the scaling critical regularity for some low dimensional cases.

35 Takashi Suzuki (Osaka Univ.) Minkowski metric and interface vanishing of non-stationary Maxwell equation 5

Summary: We study the interface vanishing of non-stationary Maxwell equation. Even if physical parameters are discontinuous, singularity of some components of the solution propagates in the light speed across the interface.

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

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

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

September 25th (Fri)

9:30–11:30

36 Hiromichi Itou (Tokyo Univ. of Sci.)
Victor A. Kovtunenko (Univ. of Graz/Lavrentyev Inst. of Hydrodynamics)
Kumbakonam R. Rajagopal (Texas A&M Univ.)
On flat-punch indentation problems within the context of linearized viscoelasticity 15

Summary: In this talk, the indentation of a flat-ended cylindrical rigid punch into a viscoelastic half-space is studied. This is closely related to the Boussinesq problem for finding the deformation in the case of a concentrated load applied on the plane boundary, by passing to the limit as the punch radius tends to zero. The indentation test has technological importance because of the ubiquitous use to determine the material properties of a body. For this problem, we assume a linear viscoelastic model wherein the linearized strain is expressed as a function of the stress. However, this expression is not invertible. Then, without use of a correspondence principle between the solutions in linearized elasticity and linear viscoelasticity, distribution of the displacement and the stress fields is obtained in the closed form, based on the Papkovich–Neuber representation in potential theory and use of the Fourier–Bessel transform for axisymmetric bodies.

37 Tetu Makino (Yamaguchi Univ.*)
On the existence of g-modes in adiabatic non-radial oscillations of gaseous stars 15

Summary: We discuss adiabatic no-radial oscillations of a gaseous star around a spherically symmetric equilibrium which touches the vacuum at a finite radius. When the square of the Brunt–Vaisala frequency on the background equilibrium has a positive minimum, then we can prove the existence of a sequence of positive eigenvalues accumulating to 0 for the linearized integro-differential operator which governs the perturbations described by Lagrangian coordinate. This is a mathematically rigorous proof of the existence of so called g-modes discussed in the astero- or helio-seismology.

38 Takuya Sato (Tohoku Univ.)[♭]
Takayoshi Ogawa (Tohoku Univ.)
L^2-decay for the one dimensional dissipative nonlinear Schrödinger equation in a critical exponent 15

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

39 Chunhua Li (Yanbian Univ.)
Yoshinori Nishii (Osaka Univ.)
Yuji Sagawa
Hideaki Sunagawa (Osaka City Univ.)
Large time asymptotics for a cubic nonlinear Schrödinger system in one space dimension, II 12

Summary: We study the Cauchy problem for the two-component system of cubic nonlinear Schrödinger equations in one space dimension. We provide criteria for large time decay or non-decay in L^2 of the small amplitude solutions in terms of the Fourier transforms of the initial data.

40 Masaru Hamano (Saitama Univ.)
Masahiro Ikeda (RIKEN/Keio Univ.)
For equivalence of conditions on initial data to the nonlinear Schrödinger equation with an inverse power potential 10

Summary: In this talk, we consider the nonlinear Schrödinger equation with a repulsive inverse power potential. First, we introduce minimization problems for the ground state to the NLS equation. Then, we deal with initial data, whose action is less than that of the ground state without the potential. We prove some global well-posedness results and some blow-up results. In addition, focusing on the time behavior of solutions to the NLS equation, we give equivalence of some conditions on the initial data.

41 Tomoyuki Tanaka (Nagoya Univ.)
Hiroyuki Hirayama (Univ. of Miyazaki)
Masahiro Ikeda (RIKEN/Keio Univ.)
Well-posedness for the fourth-order Schrödinger equation with third order derivative nonlinearities 15

Summary: We study the Cauchy problem to the semilinear fourth-order Schrödinger equations. The purpose of this talk is to prove well-posedness in the lower order Sobolev space $H^s(\mathbb{R})$ or with more general nonlinearities than previous results. Our proof of the main results is based on the contraction mapping principle on a suitable function space employed by D. Pornnopparath (2018). To obtain the key linear and bilinear estimates, we construct a suitable decomposition of the Duhamel term introduced by I. Bejenaru, A. D. Ionescu, C. E. Kenig, and D. Tataru (2011).

42 Yohei Yamazaki (Hiroshima Univ.)
Center stable manifolds around line solitary waves of the Zakharov–Kuznetsov equation with critical speed 10

Summary: In this talk, we consider center stable manifolds around unstable line solitary waves of the Zakharov–Kuznetsov equation on two dimensional cylindrical spaces. In the previous result, center stable manifolds around unstable line solitary waves have been constructed without critical speed $c \in \{4n^2/5L^2; n \in \mathbb{Z}, n > 1\}$. Since the linearized operator around line solitary waves with critical speed is degenerate, we prove the stability condition of the center stable manifold for critical speed by applying to the estimate of 4th order term of a Lyapunov function.

14:15–16:15

43 Yuuki Shimizu (Kyoto Univ.)
A current-valued solution of the Euler equations on surfaces and its applications 15

Summary: We provide a characterization of point vortex dynamics in a background field on general curved surfaces as a current-valued solution of the Euler equations. Introducing a weak formulation of the Euler equations on a surface in the space of currents, we discuss universality and existence of point vortex dynamics in a background field in certain current-valued solutions.

44 Kohei Nakao (Nagano Univ.)
On time-periodic solutions to the Boussinesq equations in exterior domains 10

Summary: We construct time-periodic solutions to the Boussinesq equations in a three-dimensional exterior domain. To this end, we estimate the L^1 norm of buoyancy, and give some estimates of the heat semigroup in the Lorentz space.

45 Takahiro Okabe (Osaka Univ.)
Lorenzo Brandolese (Univ. Lyon 1)
Annihilation of slow-decay factors of the Navier–Stokes flow by the external force 12

Summary: We consider the incompressible Navier–Stokes equations on the whole space. We derive rapid time decay of the energy of the Naiver–Stokes flow beyond the optimal decay rate by the effect of the external force. More precisely, for every (small) initial data we find a external force and the associated solution which decays rapidly. Moreover we see that we can take force which has a compact support in space-time region.

46 Itsuko Hashimoto (Kanazawa Univ./Osaka City Univ.)
Akitaka Matsumura (Osaka Univ.)
Existence of radially symmetric stationary solutions for the compressible Navier–Stokes equation 10

Summary: The present paper is concerned with the existence of radially symmetric stationary solutions for exterior problems to the compressible Navier–Stokes equation, describing the motion of viscous barotropic gas without external forces, where boundary and far field data are prescribed. For both inflow and outflow problems, the existence of a unique radially stationary solution is shown in a suitably small neighborhood of the far field state. The estimates of algebraic decay rate toward the far field state are also obtained. Furthermore, it is shown that the boundary layer of the density appears as the velocity data tend to zero in the inflow problem, but not in the outflow problem.

47 Masahiro Suzuki (Nagoya Inst. of Tech.)
Masahiro Takayama (Keio Univ.)
Stationary solutions to the Euler–Poisson equations in a perturbed half-space 15

Summary: The purpose of this talk is to mathematically investigate the formation of a plasma sheath near the surface of walls immersed in a plasma, and to analyze qualitative information of such a sheath layer. In the case of planar wall, Bohm proposed a criterion on the velocity of the positive ion for the formation of sheath, and several works gave its mathematical validation. In this talk, we study the existence and asymptotic stability of stationary solutions for the Euler–Poisson equations in a domain of which boundary is drawn by a graph. The existence and stability theorems are shown by assuming that the velocity of the positive ion satisfies the Bohm criterion at infinite distance. What most interests us in these theorems is that the criterion together with a necessary condition guarantees the formation of sheaths.

48 Masahiro Suzuki (Nagoya Inst. of Tech.)
Katherine Zhiyuan Zhang (Brown Univ.)
Stationary solutions to the Navier–Stokes equations in a perturbed half-space 15

Summary: We consider the compressible Navier–Stokes equations in a perturbed half-space with an outflow boundary condition as well as the supersonic condition. For a half-space, it has been known that a certain planar stationary solution exists and it is time-asymptotically stable. The planar stationary solution is independent of the tangential directions and its velocities of the tangential directions are zero. In this paper, we show the unique existence of stationary solutions for the perturbed half-space. The feature of our work is that our stationary solution depends on all directions and has multidirectional flow. Furthermore, we also prove the asymptotic stability of this stationary solution.

49 Yusuke Ishigaki (Tokyo Tech)
Diffusion wave phenomena and L^p decay estimates of solutions of compressible viscoelastic system 15

Summary: We consider the system of equations describing motion of compressible viscoelastic fluids in three dimensional whole space. We investigate the large time behavior of solutions around a motionless state, and obtain the L^p decay estimates of solutions for $1 < p \leq \infty$, provided that the initial data is sufficiently close to the motionless state. In addition, we clarify the diffusion wave phenomena caused by interaction of three properties; sound wave, viscous diffusion and elastic shear wave.

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

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

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

Real Analysis

September 24th (Thu)

10:00–11:55

1 Neal Bez (Saitama Univ.) Inverse Brascamp–Lieb inequalities via the heat equation ····· 15
Shohei Nakamura (Saitama Univ.)

Summary: Vaguely speaking, our interest in this talk is about the difference between two methodology, that is, the mass-transport method and the semigroup interpolation method, especially the heat flow monotonicity. To this question, we consider the inverse Brascamp–Lieb inequality which generalises the sharp forward and reverse Young's inequality, gaussian hypercontractivity for the Ornstein–Uhlenbeck semigroup, as well as Prékopa–Leindler inequality, and hence the Brunn–Minkowski inequality. This was recently established by Barthe–Wolff employing the mass-transport method. We will report that the heat flow monotonicity approach enables us to further generalise and somehow improve the inverse Brascamp–Lieb inequality. Our generalised inequalities unify most of inequalities related to the theory of the Brascamp–Lieb inequality. This talk is based on the joint work with Professor Neal Bez.

2 Aoi Honda (Kyushu Inst. of Tech.) Generalization of k-order additive monotone measure for nondiscrete space ····· 15
Ryoji Fukuda (Oita Univ.)
Yoshiaki Okazaki (Fuzzy Logic Systems Inst.)

Summary: The k-order additivity which is one of the main concepts for analyzing non-additivbe measure is considered. We introduce a generalization of the concept of the Möbius transform, and define the k-order additivity for nondiscrete monotone measure space with this. We show the the validity of this definition and essential properties of k-oider additivitiy. In addition we give several concrete examples of non-discrete k-order additive measure.

3 Sachiko Atsushiba (Tokyo Woman's Christian Univ.) Fixed points and convergence of orbits of nonexpansive semigroups ··· 15

Summary: In this talk, we prove some fixed point results for generalized contractions in Banach spaces. We prove convergence theorems for generalized contractions. We also study the asymptotic behavior of orbits of nonexpansive semigroups with no common fixed points in the interior of their domains.

4 Yukino Tomizawa (Niigata Inst. of Tech.) Uniform convexity of complete Busemann spaces ····· 15

Summary: Some distance space which are not linear spaces have properties such that the generalization of properties in linear spaces. The purpose is to elucidate what geometrical properties exist in the spaces. we report some geometric properties of complete Busemann spaces with uniform convexity.

5 Masahiro Ikeda (RIKEN/Keio Univ.)[b] Composition operators on reproducing kernel Hilbert spaces with analytic positive definite functions ····· 10
Isao Ishikawa (Ehime Univ.)
Yoshihiro Sawano (Chuo Univ.)

Summary: Composition operators have been extensively studied in complex analysis, and recently, they have been utilized in engineering and machine learning. Here, we focus on composition operators associated with maps in Euclidean spaces that are on reproducing kernel Hilbert spaces with respect to analytic positive definite functions, and prove the maps are affine if the composition operators are bounded. Our result covers composition operators on Paley–Wiener spaces and reproducing kernel spaces with respect to the Gaussian kernel on $\mathbb{R}^d$, widely used in the context of engineering.

6 Naoya Hatano (Chuo Univ./RIKEN) Masahiro Ikeda (RIKEN) Isao Ishikawa (Ehime Univ.) Yoshihiro Sawano (Chuo Univ.) Boundedness of composition operators on Morrey spaces 15

Summary: Composition operator is also said Koopman operator and is used well in the engineering field. Morrey space is a generalization of Lebesgue space, which is introduced in 1938, and attract attention recently. Our goal of the investigation is to show the necessary and sufficient condition of boundedness of composition opearators on Morrey spaces. It is well known the necessary and sufficient condition of boundedness of composition operators on Lebesgue spaces from long ago. In our investigation, we succeeded getting out the detailed informations of composing maps from the boundedness on Morrey spaces. The main result, which is a sufficient condition of boundedness on Morrey spaces, is not possible to consider by only using Lebsegue spaces.

7 Yoichi Miyazaki (Nihon Univ.) A proof of the Gagliardo–Nirenberg inequality with BMO term via Muramatu's integral formula 15

Summary: It is known that the Gagliardo–Nirenberg inequality $\|\nabla^k f\|_{L_r} \leq C\|f\|_{L_\infty}^{1-k/m}\|\nabla^m f\|_{L_p}^{k/m}$ with $r = mp/k$, $1 < p < \infty$, $1 \leq k < m$ can be improved by replacing the L_∞ norm with the BMO norm. We give a short proof of this refined inequality, using Muramatu's integral formula. Compared with the proof given by Strzelecki [Bull. London Math. Soc **38** (2006), 294–300], we do not need the duality of the Hardy space and the BMO space. We also consider the case where $\|\nabla^m f\|_{BMO}$ is concerned.

14:15–14:45

8 Ryota Kawasumi Weak-weak boundedness of commutators of generalized fractional integral operators with functions in Campanato spaces 15

Summary: We consider the commutator $[b, I_\rho]$ on weak Orlicz–Morrey spaces, where I_ρ is a generalized fractional integral operator and b is a function in generalized Campanato spaces. We show the boundedness from a weak Orlicz–Morrey space to another weak Orlicz–Morrey space. Weak Orlicz–Morrey spaces contain weak L^p spaces, weak Orlicz spaces and weak generalized Morrey spaces as special cases. Hence we get the weak-weak boundedness of these function spaces as corollaries of our result, which are also new results.

9 Ryota Kawasumi Eiichi Nakai (Ibaraki Univ.) Minglei Shi (Ibaraki Univ.) Generalized fractional integral and maximal operators on Orlicz–Morrey and weak Orlicz–Morrey spaces 15

Summary: We consider the generalized fractional integral operator I_ρ and the generalized fractional maximal operator M_ρ. We give necessary and sufficient conditions for the boundedness of I_ρ and M_ρ on Orlicz–Morrey and weak Orlicz–Morrey spaces. Orlicz–Morrey spaces contain L^p spaces, Orlicz spaces and generalized Morrey spaces as special cases. Hence we get necessary and sufficient conditions for the boundedness of I_ρ and M_ρ on these function spaces as corollaries.

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

Gaku Sadasue (Osaka Kyoiku Univ.) Martingale spaces and fractional integrals

Summary: In this talk, we give definitions of several martingale spaces, and study the boundedness of martingale transforms on these spaces. We especially study a special class of martingale transforms called fractional integrals.

September 25th (Fri)

9:45–12:00

10 Chiharu Kosugi (Japan Women's Univ.)
Toyohiko Aiki (Japan Women's Univ.)
Uniqueness of weak solutions to initial and boundary value problems representing motion of the elastic material on plane 15

Summary: In this talk we consider uniqueness of weak solutions to an initial boundary value problem for beam equations. This problem represents motion of the elastic material (for example rubber rings), and is to find a closed curve defined on the closed interval [0,1]. We note that the strain is given by a nonlinear function of the derivative of the unknown function so that we define a solution in a weak formulation. The existence of the solution was already shown. The aim of this talk is to prove a theorem on uniqueness of weak solutions. In our proof by applying the dual equation method we establish the uniqueness of weak solutions.

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

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

12 Masaaki Mizukami (Tokyo Univ. of Sci.)
Uniform-in-time estimates for solutions of a chemotaxis-competition model and those of the Lotka–Volterra competition model 15

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

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

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

14 Shodai Kubota (Chiba Univ.)
Ken Shirakawa (Chiba Univ.)
Optimal control problems for multidimensional systems of Kobayashi–Warren–Carter type 15

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

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

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

16 Ken Shirakawa (Chiba Univ.)
Hiroshi Watanabe (Oita Univ.)
Sufficient condition for the existence of one-dimensional crystalline solution of the Kobayashi–Warren–Carter type system 15

Summary: This summary is the same with that for the presentation at the last MSJ Spring Meeting 2020. In this talk, we consider a one-dimensional Kobayashi–Warren–Carter type system, which is based on a phase-field model of grain boundary motion. This talk corresponds to a continuation of the last presentation at MSJ Spring Meeting 2019 (Tokyo), which was concerned with the uniqueness of special kind of solution, named "crystalline solution". On this basis, we here focus on the existence issue of crystalline solution. Through the precise observations for solutions to a time-discretization scheme, a class of structural conditions for the initial data will be presented as the sufficient condition for the existence of crystalline solution.

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

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

14:15–15:15

18 Kota Kumazaki (Nagasaki Univ.)[♭]
Large time behavior of a solution of a one-dimensional free boundary problem describing water swelling 15

Summary: In this talk, we consider a mathematical model describing swelling of a pocket of water in porous materials. Our problem is posed on a halfline with a moving boundary at one of the ends, and the moving boundary conditions encode the swelling mechanism, while a diffusion equation is responsible for providing water content for the swelling to take place. Recently, we investigate the large time behavior of the free boundary position and see that the moving interfaces grows indefinitely unless the production term by Henry's law has a certain decay in time. In this talk, we discuss the existence and uniqueness, large time behavior of a solution to our problem.

19 Shun Uchida (Oita Univ.) Solvability of doubly nonlinear parabolic equations with p-Laplacian 15

Summary: We are concerned with the initial boundary value problem of $\partial_t \beta(u) - \Delta_p u \ni f$ in a bounded domain with the homogeneous Dirichlet boundary condition, where β is (multi-valued) maximal monotone graph in $\mathbb{R}$ and $\Delta_p u := \nabla \cdot (|\nabla u|^{p-2}\nabla u)$. The main purpose of this talk is to show the existence of solutions without boundedness, growth order, and coercivity conditions of β.

20 Hiroshi Watanabe (Oita Univ.) Traveling waves with multiple points of discontinuities to scalar parabolic-hyperbolic conservation laws 15

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

21 Toshitaka Matsumoto (Shizuoka Univ.)
Hirokazu Oka (Ibaraki Univ.)
Naoki Tanaka (Shizuoka Univ.) Well-posedness and approximation solvability for evolution equations governed by quasilinear operators satisfying Carathéodory's conditions 15

Summary: Evolution equations governed by quasilinear operators satisfying Carathéodory's conditions are studied. Time-local and time-global well-posedness results as well as approximation solvability results are given.

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

Keisuke Takasao (Kyoto Univ./Kyoto Univ.) On the existence of the weak solution for the mean curvature flow with forcing term via the phase field method

Summary: We study the mean curvature flow with given non-smooth forcing term g. In 1993, Ilmanen proved the existence of the Brakke flow without forcing term, by using the phase field method. Generally, the most difficult part of the proof of the existence theorem is the estimate of the positive part of the discrepancy measure. To solve the problem, Ilmanen showed the non-positivity of the discrepancy measure via the maximum principle. However, in the case of $g \neq 0$, the property does not hold for the usual phase field method of the problem. In this talk, we explain a new modified Allen–Cahn equation which satisfies the non-positivity of the discrepancy measure, and we prove the global existence of the weak solution for the mean curvature flow with forcing term in suitable Sobolev spaces.

Functional Analysis

September 22nd (Tue)

10:00–11:45

1 Hiroshi Inoue (Daiichi Univ. of Pharm.) Non-self-adjoint hamiltonians defined by biorthogonal sequences and sesquilinear forms ····· 15

Summary: In this talk, we introduce a theory of sesquilinear forms with respect to non-self-adjoint hamiltonian and its physical operators. In particular, we discuss some features of non-self-adjoint operators and sesquilinear forms which are defined starting from biorthogonal sequences which are not Riesz bases, generalized Riesz systems, D-quasi bases and $(D, \mathcal{E})$-quasi bases.

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

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

3 Kyohei Itakura (Ritsumeikan Univ.) Stationary scattering theory for repulsive Hamiltonians ····· 15

Summary: We investigate stationary scattering theory for Hamiltonians with spherically symmetric repulsive potential. For such Hmailtonians we already studied spectral theory and obtained some results for generalized eigenfunctions and resolvents on proper spaces. To construct stationary scattering theory radiation condition bounds for limiting resolvents play a crucial role. We are going to talk about construction of stationary wave matrices and its properties.

4 Toshimitsu Takaesu (Gunma Univ.) Scaling limits with a removal of ultraviolet cutoffs for the system of semi-relativistic particles coupled to a Klein–Gordon field ····· 15

Summary: We consider the system of semi-relativistic particles coupled to a Klein–Gordon field. A scaled total Hamiltonian for the system is defined on a tensor product of a square-integrable function space and a boson Fock space. We consider the strong resolvent limit of a renormalized Hamiltonian, which is defined by subtracting a divergent term from the scaled total Hamiltonian. By an abstract scaling limit theory and a unitary transformation, effective potentials of particles are derived.

5 Yoritaka Iwata (Kansai Univ.) Application of abstract Miura transform to higher order abstract evolution equations ····· 15

Summary: Miura transform is known as the transformation between Korteweg–de Vries (KdV) and modified KdV (mKdV) equations. In this talk, based on the logarithmic representation of operators [1-9] in Banach spaces, the mathematical structure of the Miura transform is explained in the detail. In conclusion, by means of the abstract version of the Miura transform [8] in Banach spaces, the representation of formal solution to second order evolution equations is presented. It shows a rigorous-solution representation for both infinitesimal generators and evolution operators (cf. the representation of exponentials in Hille–Yosida theorem).

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

Summary: In the preceding talk, the present author gave a proof of the statement that the transition to a superconducting state is a second-order phase transition in the BCS-Bogoliubov model of superconductivity on the basis of fixed-point theorems, and solved the long-standing problem of the second-order phase transition from the viewpoint of operator theory. In this talk we study the temperature dependence of the specific heat of a superconductor in the model from the viewpoint of operator theory. We give the exact and explicit expression for the gap in the specific heat divided by the specific heat. We then show that it does not depend on superconductors and is a universal constant.

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

Fumio Hiroshima (Kyushu Univ.) Renormalization and the ground state by functional integrations

Summary: The Nelson model is a typical quantum field model coupled with a Schrödinger operator. In order to define this model as a self-adjoint operator, we first need UV cutoff. Nelson himself proved that the model can be renormalized about 50 years ago. Alternative proof using path integral was recently given by Gubinell–Hiroshima–Lorinczi (14). Let H be the renormalized Nelson Hamiltonian. Although the explicit form of H is unknown, Nelson himself gave H in a quadratic form. The existence of the ground state is shown by Hirokawa–Hiroshima–Spohn (05) when the coupling constant is sufficiently small. The research on the ground state of H has made great progress and final conclusions have been obtained in Hiroshima–Matte (19). We discuss the existence and absence of the ground state for arbitrary values of coupling constants by Feynman–Kac formula, and the localization of the ground state is shown by using an infinite volume Gibbs measure.

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

Fumihiko Nakano (Tohoku Univ.)$^{\flat}$ Scaling limit of the eigenvalues and eigenfunctions of 1-dimensional random Schrödinger operators

Summary: One-dimensional Schrödinger operators have rich spectral and statistical properties, depending on the decay order of the potential at infinity. In this talk, we discuss: (i) fluctuation of integrated density of states (ii) spectral statistics (iii) scaling limit of eigenfunctions

September 23rd (Wed)

10:30–11:45

7 Koei Kawamura (Kyoto Univ.)$^{\flat}$ Decomposition of spherical representations and an addition theorem for multivariate hypergeometic polynomials ····· 15

Summary: We aim addition theorems for multivariate Krawtchouk polynomials, following Dunkl [2] for 1-variate case. We work on harmonic analysis on a nonArchimedean local field, that is a group theoretic situation where these polynomials play roles of the zonal spherical functions. We need some hypotheses to make the functions decomposed with multiplicity free. Then we have an addition theorem for multivariate Krawtchouk polynomials which includes expansions by multivariate Hahn polynomials.

8 Hideto Nakashima (Nagoya Univ.) On Capelli-type identities of rings of invariant differential operators on generalized Vinberg cones ····· 15

Summary: We consider rings of differential operators on generalized Vinberg cones, which are invariant under the actions of split solvable Lie groups acting on the cones simply transitively. Explicit expressions of their generators are given. Moreover, we present Capelli-type identities for these cones.

9 Nobukazu Shimeno (Kwansei Gakuin Univ.)
Naoya Tani (Kwansei Gakuin Univ.)
An extension of Pizzetti's formula in Dunkl analysis 15

Summary: We give an extension of Pizzetti's formula associated with the Dunkl operators. It gives an explicit formula for the Dunkl inner product of an arbitrary function and a homogeneous Dunkl harmonic polynomial on the unit sphere.

10 Nobukazu Shimeno (Kwansei Gakuin Univ.)
Tatsuo Honda
Hiroshi Oda (Takushoku Univ.)
Hypergeometric Fourier transform associated with a root system of type BC 15

Summary: We give the inversion formula and the Plancherel formula for the hypergeometric Fourier transform associated with a root system of type BC, when the multiplicity parameters are not necessarily nonnegative.

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

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

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

September 24th (Thu)

10:00–12:00

11 Kiyoki Tanaka (Daido Univ.)
Satoshi Yamaji (Kobe City Coll. of Tech.)
Essential norm estimates for little Hankel operators on Bergman spaces 15

Summary: Bonami–Luo gave a characterizaion of bounded little Hankel operators on Bergman spaces with anti holomorphic symbols. In this talk, we announce a result of essential norm estimates for little Hankel operators on Bergman spaces with anti holomorphic symbols. In particular, we give a characterization of compactness of little Hankel operators on Bergman spaces with anti holomorphic symbols.

12 Yasuo Iida (Kanazawa Med. Univ.)
Bounded subsets of the Zygmund F-algebra 15

Summary: We will consider some characterizations of boundedness in the Zygmund F-algebra $N \log^{\alpha} N(X)$ $(\alpha > 0)$ of holomorphic functions f on the unit polydisk or the unit ball that satisfy

$$\sup_{0 \le r < 1} \int_{\partial X} \varphi_{\alpha}(\log^{+} |f(r\zeta)|)\, d\sigma(\zeta) < \infty,$$

where $\varphi_{\alpha}(t) = t\{\log(c_{\alpha} + t)\}^{\alpha}$ for $t \ge 0$ and $c_{\alpha} = \max\{e\,,\, e^{\alpha}\}$.

13 Sei-Ichiro Ueki (Tokai Univ.)
Isometries of the Novinger–Oberlin type Privalov space 10

Summary: We introduce the space of analytic functions on the open unit disk whose derivative belong to the Privalov space. We will give the characterization of a linear isometry of this space. We also characterize the surjective, not necessarily linear, multiplicative isometry of this space.

14 Shiho Oi (Niigata Univ.) Surjective linear isometries on algebras of Lipschitz maps with the values in the matrix algebra ····· 15

Summary: The study of isometries on vector-valued Lipschitz maps with the ℓ_1-norm has been researched recently. To develop the study, we show Hermitian operators on spaces of Lipschitz maps taking values in finite dimensional Banach spaces are composition operators. By the characterization, we give a characterization for unital surjective linear isometries on spaces of Lipschitz maps with the values in the algebra of complex matrices.

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

Summary: In this talk, we will consider the forms of surjective isometries on some Banach space of analytic functions on the open unit disc.

16 Takeshi Miura (Niigata Univ.) On surjective isometries on Lipschitz space of analytic functions ····· 15

Summary: We characterize surjective, not necessarily linear, isometries on Lipschitz space of all analytic functions on the open unit disc.

17 Hironao Koshimizu (Yonago Nat. Coll. of Tech.)
Takeshi Miura (Niigata Univ.) Surjective isometries on uniform algebra valued C^1 space ····· 15

Summary: Let A be a uniform algebra. We denote by $C^1([0,1],A)$ the complex linear space of all A-valued continuously differentiable maps on the closed unit interval $[0,1]$. We give the characterization of surjective, not necessarily linear, isometries on $C^1([0,1],A)$.

14:15–15:10

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

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

19 Masaru Nagisa (Chiba Univ.)
Hiroyuki Osaka (Ritsumeikan Univ.)
Priyabrata Bag (Narsee Monjee Inst. of Management Stud.)
Santanu Dey (Indian Inst. of Tech. Bombay) Subspaces generated by orthonormal vectors of some Scmidt ranks ··· 15

Summary: We consider a bipartite Hilbert space $H = \mathbb{C}^m \otimes \mathbb{C}^n$. When $n, m \geq 4$, we construct three subspaces $(\mathcal{S} \supset \mathcal{T} \supset \mathcal{U})$ of H. These subspaces are generated by orthonormal vectors which have a special Schmidt rank. Our interst is to give a special form of bases for them.

20 Yuki Seo (Osaka Kyoiku Univ.) Norm inequalities of n-variable matrix geometric means ····· 15

Summary: In this talk, we show norm inequalities of matrix power means, by using a Ando–Hiai type complementary inequality of matrix power means. As an application, we show norm inequalities of the Karcher mean of positive definite matrices. These results are extensions of two-variable version with respect to the matrix geometric mean.

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

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

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

Statistics and Probability

September 22nd (Tue)

9:00–12:00

Summary: In this talk, we will discuss biased RWs on Galton–Watson trees, which are very classic model of random trees. In particular, we aim at explaining intricate interplay between the bias to which a random walk is subjected and a complicated geometric structure of Galton–Watson trees. This talk is based on joint works with Adam Bowditch (National University of Singapore).

Summary: We discuss the intersections of the d-dimensional Sierpiński gasket with $(d-1)$-dimensional hyperplanes in a particular fixed direction. We give the values of the Hausdorff dimension, the lower box dimension, the upper box dimension, and the packing dimension of each slice and determine the criterion for which the Hausdorff dimension of the slice takes Marstrand's value.

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

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

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

Summary: We propose a new numerical method for one dimensional stochastic differential equations (SDEs). The main idea of this method is based on a representation of a weak solution of a SDE with a time changed Brownian motion, dated back to Doeblin (1940). In cases where the diffusion coefficient is bounded and β-Hölder continuous with $0 < \beta \leq 1$, we provide the rate of strong convergence. An advantage of our approach is that we approximate the weak solution, which enables us to treat a SDE with no strong solution. Our scheme is the first to achieve the strong convergence for the case $0 < \beta < 1/2$.

Summary: In the recent years, time-inconsistent stochastic control problems have received remarkable attentions in stochastic control, mathematical finance and economics. In this talk, we investigate a Nash equilibrium control for a time-inconsistent stochastic recursive control problem where the cost functional is defined by the solution to a backward stochastic Volterra integral equation (BSVIE, for short), which is a generalization of a backward stochastic differential equation (BSDE, for short). We provide a necessary and sufficient condition for a Nash equilibrium control via variational methods. The key point of our analysis is to derive the corresponding adjoint equations wihch turn out to be the so-called extended backward stochastic Volterra integral equations (EBSVIEs, for short).

Summary: We are concerned with certain phase transition phenomena arising in a family of stochastic ergodic control problems having some real parameter. We assume that the drift vector of the controlled diffusion is bounded and inward pointing and the potential function in the cost functional is positive and vanishing at infinity. Then, it may happen that the large time behavior of the optimal diffusion changes drastically in the vicinity of some critical value of the parameter. We specify a necessary and sufficient condition so that such a phase transition occurs. The key lies in the analysis of solutions to the associated viscous Hamilton–Jacobi equation of ergodic type.

Summary: When $d \geq 3$, we study the existence of a different d-dimensional symmetric stable distribution which shares the same $(d-1)$-dimensional marginal distributions with a given d-dimensional symmetric stable distribution whose spectral measure is constructed by point masses.

Summary: We discuss integration by parts formulas for the joint law of a stable process and its maximum. The argument is based on a multi-level representation for the joint law which uses the theory of convex majorants for stable processes and the Chambers–Mallows–Stuck representation for stable random variables. As applications, we obtain regularity results for the joint law and upper bounds for the density and its space derivatives up to the boundary.

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

12 Hiroshi Kawabi (Keio Univ.)♭ Sergio Albeverio (Univ. of Bonn) Stefan-Radu Mihalache (BaFin) Michael Röckner (Bielefeld Univ.) — Uniqueness of Dirichlet forms related to stochastic quantization under exponential/trigonometric interactions on the two-dimensional torus · · 15

Summary: In this talk, we consider Dirichlet forms given by two-dimensional space-time quantum fields with exponential/trigonometric interactions in finite volume. In the context of Euclidean quantum field theory, the former quantum field and the latter one are called the Hoegh–Krohn model and the sine-Gordon model, respectively. We prove strong uniqueness of the corresponding Dirichlet operator and construct a weak solution (in the probability sense) of the modified-stochastic quantization equation under suitable conditions on the charge constant and the regularization parameter.

14:20–15:20 Talk Invited by Statistics and Probability Section

Yoshihiro Abe (Chiba Univ.) Covering problems for random walks

Summary: The covering process by a simple random walk on a finite lattice has been intensively studied by physicists and probabilists. They have been especially interested in the cover time, which is the first time at which the walk visits every vertex and statistics of unvisited points, called late points. They have found dimension-dependent properties in the covering process. In three and higher dimensions, late points are independent and uniform in some sense and the cover time converges in law to a Gumbel distribution. In two dimensions, late points are fractal-like and forms clusters and it is believed that the cover time would weakly converge to a randomly-shifted Gumbel distribution. In this talk, I will review research on these covering problems.

15:40–16:40 Talk Invited by Statistics and Probability Section

Makoto Katori (Chuo Univ.) Elliptic extensions of determinantal point processes

Summary: A point process is a statistical ensemble of random nonnegative-integer-valued Radon measures on a space equipped with a reference measure. We consider the case in which for any integer n an n-point correlation function is well defined with respect to the n-product of reference measure. When an n-point correlation function is given by a determinant of $n \times n$ matrix for every n and the entries of matrices are determined by a kernel of an integral operator, the point process is said to be determinantal and the kernel is called the correlation kernel. Many examples of determinantal point processes (DPPs) have been studied in random matrix theory and correlation kernels provide reproducing kernels which construct reproducing kernel Hilbert spaces. Recently we are interested in the DPPs in which correlation kernels are expressed using Jacobi's theta functions and Weierstrass' elliptic functions. In the present talk we will explain that these new examples of DPPs can be regarded as elliptic extensions of the classical DPPs and their q-extensions (trigonometric extensions). In particular we will report an elliptic extension of the beautiful work by Peres and Virág published in 2005, who considered the Gaussian analytic function (GAF) on a unit disk $\mathbb{D}$ defined as an ensemble of random power series with i.i.d. complex Gaussian coefficients. There the covariance kernel of GAF is given by the reproducing kernel of the Hardy space on $\mathbb{D}$ called the Szegő kernel of $\mathbb{D}$. They showed that zeros of the GAF form a DPP whose correlation kernel is equal to the Bergman kernel of $\mathbb{D}$. This talk is based on the joint work with Tomoyuki Shirai (IMI, Kyushu University).

September 23rd (Wed)

9:00–11:15

13 Toshiharu Fujita (Kyushu Inst. of Tech.) — On policy for Markov decision process with converging branch system · · · 10

Summary: We consider a Markov decision process model with a converging branch system which is one of the nonserial transition systems. We have introduced recursive equations by using dynamic programming technique. In this study, we investigate the optimal policy obtained by our recursive equations.

Summary: Dropout is used in deep learning. It is a method of learning by invalidating nodes with randomly for each layer in the multi-layer neural network. And it deletes a random sample of activations (nodes) to zero during the training process. A random sample of nodes cause more irregular frequency of dropout edges. A dropout design is a combinatorial design on dropout nodes from each partite which balances frequency of edges. In this talk, we give some related structure and properties with dropout designs.

Summary: Circulant almost orthogonal arrays (CAOAs) are a class of circulant arrays introduced by Y.-L. Lin, F. K. H. Phoa, and M.-H. Kao [Ann. Stat., 45(6), 2483–2510, 2017] as designs for fMRI experiments. In this talk, I will focus on $k \times n$ two-level CAOAs with strength 2 and bandwidth 1, denoted by CAOA$(n, k, 2, 2, 1)$, and talk about their optimality and the D-efficiency. Moreover, by showing the relationship between CAOA$(n, k, 2, 2, 1)$ and perfect balanced binary sequences which are well studied in information theory, new CAOA$(n, k, 2, 2, 1)$ with large k and high D-efficiency are obtained.

Summary: Li et al. have newly introduced a combinatorial array, called a perpendicular multi-array, in 2018 for constructions of splitting authentication codes having some perfect t-fold secrecy. In this talk, necessary conditions for the existence of a perpendicular multi-array are discussed, and it is shown that the necessary conditions are also sufficient for the existence of a perpendicular multi-array with block size 3×2 with the only one exception. Finally, the asymptotic existence of perpendicular multi-arrays with a cyclic automorphism is presented.

Summary: We derive exact formulas for the χ^2 statistics of the distribution of the leading digit of a^n, where $\log_{10} a$ has a large first or second partial quotient in its continued fraction expansion.

Summary: Sampling distributions for the linear discriminant function are very complicated and they are not easily calculated. As a result, the great attention has been paid to derive asymptotic expansions for the linear discriminant function. However, asymptotic expansions cannot be expected to approximate the exact distributions of the linear discriminant function for small sample sizes. In this report, we consider the distributions of the linear discriminant function in a Bayesian setting. We derive the predictive density for the linear discriminant function. This density are expressed as one dimensional integral. In addition, it is applied to derive the cumulant generating function and cumulative distribution functions.

19 Ayaka Yagi (Tokyo Univ. of Sci.)
Mizuki Onozawa (Showa Elementary School)
Takashi Seo (Tokyo Univ. of Sci.)
A new test statistic for two mean vectors with two-step monotone missing data ····· 15

Summary: Testing problem for the equality of two mean vectors with two-step monotone missing data is considered. Yu et al. (2006) proposed the T^2-type test statistic for this problem and gave the approximation to the upper percentiles of this statistic. Yagi et al. (2018) derived its approximate null distribution in the form of an asymptotic expansion. In this talk, we propose a new test statistic which replaced part of the above statistic. Further, we exactly derive an asymptotic expansion for the new test statistic. Moreover, we present the approximation to the upper percentiles of this statistic based on Yu et al. (2006) and propose the transformed test statistics. Finally, we numerically investigate the accuracy and asymptotic behavior of the proposed approximation and transformed test statistics.

20 Yoshihide Kakizawa (Hokkaido Univ.)
Multivariate BS type distribution and its application to nonparametric density estimation ····· 15

Summary: In this talk, we consider nonparametric density estimation for the data supported on $[0,\infty)^d$. To define a new estimator, we first review the Birnbaum–Saunders (BS) distribution theory, together with various extensions (non-central version, elliptical-based construction, link to its logarithm version, and skew-based construction). Then, we study the asymptotic properties of the proposed density estimator in the bivariate case.

21 Gaku Igarashi (Univ. of Tsukuba)
A test on discontinuity of densities using nonparametric beta kernel density ratio estimation ····· 15

Summary: The kernel density estimation requires an assumption of continuity (smoothness) of an estimated density. Even if the underlying density has some discontinuity points, the features are not estimated. In this talk, a test on discontinuity of a density is discussed. The nonparametric beta kernel direct density ratio estimator proposed by Igarashi (2020) is applied to obtain a test statistic.

11:30–12:00 Research Section Assembly

September 24th (Thu)

9:00–11:50

22 Yuichi Goto (Waseda Univ.)
Distribution free tests for structural break of counting processes ····· 15

Summary: In this talk, we discuss testing for a structural break of counting processes. Intensity functions of the counting processes in our models have non-linear dependence structures including INGARCH(p,q) models. We elucidate the asymptotic null distributions of the Wald, modified Wald, score, residual based CUSUM test statistics, and these enable us to construct distribution-free tests. Moreover, the test based on the modified Wald statistic is consistent in the sense of power. A simulation suggests that the residual based test is best among the proposed tests.

23 Yujie Xue (Waseda Univ.)
The pros of cons on the combination of linear quantile regression and LASSO with long-memory disturbances ····· 15

Summary: In this talk, LASSO is applied to the linear quantile regression models with long-memory disturbances. Considering that there exists the situation that the norm of different column in the regression matrix may have different order of sequence length n, we introduce a modified LASSO estimator where the tuning parameter λ is not a scalar but a vector. Two situations where the dimension of parameters p is fixed, and where p increases as n increases are discussed. Besides, some simulation studies are examined with a comparison with some other approaches.

Summary: We propose a topological approach to statistically visualizing the Granger causality. Granger introduced his celebrated new measure for the causality between multiple time series by prediction errors 50 years ago. We localize an alternative version of his idea, a natural refinement by Hosoya, and construct a new theory based on locally stationary processes. Some causality relations between Japanese and US stocks are wonderfully illustrated by our new methodology.

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

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

Summary: By classical stopping rules Guttman–Kaiser rule, Jolliffe's rule and a stopping rule based on broken-stick model, we compute the number (ratio) of principal components to retain for microarray datasets, and for Marčhenko–Pastur's setting, i.e. the standard normal p-dimensional population with the sample size $n \to \infty$ being $c = p/n$ fixed. For typical cDNA datasets, we have $c > 10$ and (Guttman–Kaiser) > (Broken stick model) > (Jolliffe). For Marčhenko–Pastur setting, (Guttman–Kaiser) > (Jolliffe) for $0.4 < c < 2.5$, and broken stick model convergences to 0 for all $c > 0$.

28 Koji Tsukuda (Kyushu Univ.)
Shun Matsuura (Keio Univ.)
High-dimensional limit theorem associated with trace of four Wishart matrices and its application 15

Summary: The Wishart distribution is a classical distribution of random matrices, and a lot of studies have investigated its asymptotic properties under the traditional regime of multivariate statistics: $n \to \infty$ with fixed p, where n denotes the degree-of-freedom and p is the size of the matrix parameter of the distribution. On the other hand, recently more and more studies considered another regime of high-dimensional statistics: $n \to \infty$ together with $p \to \infty$. In this presentation, we derive a new property of the Wishart distribution; in particular, the asymptotic normality of the trace of products of four independent Wishart matrices under a high-dimensional regime is shown. As an application of the result, we propose a test procedure for the common principal components hypothesis.

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

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

30 Yugo Nakayama (Kyoto Univ.)
Kazuyoshi Yata (Univ. of Tsukuba)
Makoto Aoshima (Univ. of Tsukuba)
Clustering by kernel principal component analysis for high-dimensional data 15

Summary: In this talk, we consider clustering based on the kernel principal component analysis (KPCA) for high-dimensional data. We investigate asymptotic properties of the KPCA with the typical kernel functions such as the linear kernel and the Gaussian kernel. We give theoretical reasons why the Gaussian kernel is effective for clustering high-dimensional data. In addition, we discuss a choice of the scale parameter yielding a high performance of the KPCA with the Gaussian kernel. We give asymptotic properties of the KPCA in a general framework of the kernel functions. Finally, we check the performance of the clustering by using numerical simulations and microarray data sets.

31 Noboru Nomura (Kochi Univ.)
Evaluation of derivatives in the calculation of orthant probabilities with orthogonal projection 15

Summary: In this talk, a procedure to evaluate derivatives by parameters of orthant probabilities with Gaussian distribution is considered. It is constructed by improving the procedure to evaluate the value of orthant probabilities. The evaluation of an orthant probability is converted to a problem that random vector falls in a polyhedral cone. The cone is divided into small cones and the probability that the vector falls in a small cone is evaluated by a problem of smaller dimension and one-dimensional integral. For more than two dimensional cases, the orthant probability is p-dimensional integral of probability density function, and its derivative is the $(p-1)$-dimensional integral. It is shown that the intermediate values required to evaluation these integrals are shared in the procedure, and the derivatives of orthant probabilities can be given with a small additional computational cost.

14:20–15:20 Talk Invited by Statistics and Probability Section

Yuta Koike (Univ. of Tokyo) Recent progress in high-dimensional central limit theorems

Summary: We review the recent progress of Gaussian approximation theory in high-dimensions. We obtain different approximation rates depending on how to quantify the distance between objective statistics and approximating Gaussian vectors. We will also discuss the optimality of the existing approximation rates and unsolved problems in this area.

15:40–16:40 Talk Invited by Statistics and Probability Section

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

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

Applied Mathematics

September 22nd (Tue)

9:50–11:45

1 Tatsuya Tsurii (Osaka Univ. of Human Sci.)
Naoharu Ito (Nara Univ. of Edu.)
Toyoki Matsuyama (Nara Univ. of Edu.)
Periodicity of n-state Fourier walks on complete graphs with self-loops 10

Summary: This paper studies n-state Fourier walks on complete graphs with a self-loop at each vertex. The periodicity of the n-state Fourier walk has been determined by its evolution matrix. It is shown that the n-state Fourier walk is periodic with period $4n$.

2 Ayaka Ishikawa (Yokohama Nat. Univ.)
A family of quantum walks on finite graphs 15

Summary: The Grover walk is a quantum walk model on a finite graph. Konno–Sato's theorem implies that the Grover transition matrix is the edge matrix of the weighted zeta functions of the 2nd kind. The weighted zeta function of the 2nd kind belongs to a wider class of graph zeta functions, called the generalized weighted zeta functions. We give a family of quantum walk models corresponding to the generalized weighted zeta functions, which contains the Grover walk.

3 Kaname Matsue (Kyushu Univ.)
Etsuo Segawa (Yokohama Nat. Univ.)
An interpolation between unitary quantum walk and open quantum random walk 15

Summary: We introduce an intermediate walk between unitary quantum walks and open quantum random walks on one-dimensional lattice by controlling decoherence with parameters $s \leq 0 \leq t$. If $s = t = 0$ and $s = -\infty, t = \infty$, then an open quantum random walk and a unitary quantum walk are recovered, respectively. The fundamental idea is based on considering a quantum walk with the Dirichlet cut of the stripe $D_{s,t} \subset \{(x, y) \in \mathbb{Z} \mid s \leq x - y \leq t\}$ in the *two*-dimensional lattice and introducing a measure on the diagonal line $x = y$. We demonstrate that the width of the stripe controls the strength of the decoherence by a numerical simulation and also analytically show spectral analysis and limit theorems on the case for $|s - t| = 1$ using Kato's perturbation theory.

4 Iwao Sato (Oyama Nat. Coll. of Tech.)
Norio Konno (Yokohama Nat. Univ.)
Hideo Mitsuhashi (Hosei Univ.)
Hideaki Morita (Muroran Inst. of Tech.)
The trace formula with respect to the Grover matrix of a graph 15

Summary: We present a trace formula with respect to the Grover matrix that is the transition matrix of the Grover walk on a graph.

5 Hideaki Morita (Muroran Inst. of Tech.)
On the Hashimoto expression for graph zeta functions 15

Summary: It is observed that graph zeta functions usually have the determinant expression of Hashimoto type. In this talk, we will see that there are a graph zeta which does not have the Hashimoto expression and it arises naturally in the usual context of graph zetas.

6 Masato Kobayashi (Kanagawa Univ.)[b]
q-determinant, q-Vandermonde and signed bigrassmannian polynomials 15

Summary: In combinatorics, it is always interesting to ask what a q-analog of something is. In studying the poset structure of alternating sign matrices around 2015, I came up with a series of three ideas as in the title. In particular, the first two are more general ideas of the classical determinant and Vandermonde. In my talk, I will give more details.

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

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

14:15–15:30

8 Masahiro Hachimori (Univ. of Tsukuba)
Nonpure simplicial complexes and sequential partitionability 15

Summary: In this talk we consider three kinds of stronger variations of partitionability of nonpure simplicial complexes: (A) having a partition in a sequential manner, (B) having a partition compatible with its h-triangle, (C) the simplicial complex itself as well as its every pure skeletons are partitionable. We show that (A) and (B) are equivalent, and that (C) is strictly weaker than the others. We call this (A) and (B) as sequential partitionability. As examples of such sequentially partitionable simplicial complexes, we then show that simplicial complexes with star-shaped realizations are sequentially partitionable.

9 Mitsuhiro Miyazaki (Kyoto Univ. of Edu.)
On the Gorenstein property of the Ehrhart rings of some types of stable set polytopes of a graph 15

Summary: Let $G = (V, E)$ be a finite simple graph. We denote by $\mathbb{R}^V$ the set of maps from V to $\mathbb{R}$ and treat as the $\#V$-dimensional Euclidean space. We set $\mathrm{HSTAB}(G) := \{f \in \mathbb{R}^V \mid f(x) \geq 0$ for any $x \in V$, $\sum_{k\in K} f(k) \leq 1$ for any clique K and $\sum_{c\in C} f(c) \leq \frac{\#C-1}{2}$ for any odd cycle $C\}$, $\mathrm{TSTAB}(G) := \{f \in \mathbb{R}^V \mid f(x) \geq 0$ for any $x \in V$, $\sum_{x\in e} f(e) \leq 1$ for any $e \in E$ and $\sum_{c\in C} f(c) \leq \frac{\#C-1}{2}$ for any odd cycle $C\}$ and $\mathrm{QSTAB}(G) := \{f \in \mathbb{R}^V \mid f(x) \geq 0$ for any $x \in V$ and $\sum_{k\in K} f(k) \leq 1$ for any clique $K\}$. In this talk, we give criteria for the Gorenstein property of the Ehrhart rings of these convex polytopes.

10 Hiroki Kajiura (Hiroshima Univ.)
Makoto Matsumoto (Hiroshima Univ.)
Takayuki Okuda (Hiroshima Univ.)
Integration error bounds for a finite subset of commutative association schemes and a generalization of difference sets. 15

Summary: Let X be a finite set, $(X, \{R_i\}_{i=0}^d)$ a commutative association scheme, k_i its i-th valency, $\{E_j\}_{j=0}^d \subset \mathbb{C}^{X\times X}$ the primitive idempotents of its Bose–Mesner Algebra, and d_j the rank of E_j. For a function $f : X \to \mathbb{C}$, let f_j be its j-th component (i.e. the convolution with E_j). We define a (seemingly strange) norm $\left\|\sum_{j=0}^d f_j\right\|_{\sqrt{\dim}} := \sum_{j=0}^d \sqrt{\sum_{x\in X} |f_j(x)|^2 d_j}$. For a non-empty finite set Y, we denote by $I_Y(f) \in \mathbb{C}$ the average of f over Y, and define the integration error $\mathrm{Err}(f : Y) := \|I_X(f) - I_Y(f)\|$. We show an error bound $\sup_{f\in\mathbb{C}^X} \mathrm{Err}(f : Y)/\|f\|_{\sqrt{\dim}} \geq \sqrt{\frac{1/\#Y - 1/\#X}{\#X-1}}$, and prove that the equality holds if and only if Y is "a difference set" in the association scheme. Here, the notion of "difference set" is a suitable generalization of well-studied difference sets, from finite groups to association schemes.

11 Hiroki Kajiura (Hiroshima Univ.)
A generalization of difference sets to association schemes and 2-designs 15

Summary: Let G be a finite group. There is a notion of difference set in G, which is a subset $Y \subset G$. Bruck proved that this notion is equivalent to that the G-orbit $G \cdot Y \subset \binom{G}{k}$ being a 2-design, where $k = \#Y$. We give a generalization of this result. We define a notion of difference set in an association scheme. If the association scheme is the thin-scheme of a finite group G, this notion coincides with the original one. Our main result is the following: if the association scheme is a Schurian association scheme (associated with a transitive action of G on a finite set X), then $Y \subset X$ is a difference set (in our sense) if and only if $G \cdot Y \subset \binom{X}{k}$ is a 2-design. We note that the original notion gives symmetric designs, but we have no examples of symmetric designs by this generalization.

12 Shohei Satake (Kumamoto Univ.) Near-homogeneous tournaments from almost difference sets ····· 15

Summary: A tournament is an oriented complete graph. Near-homogeneous tournaments proposed by Tabib (1980) are known as an important class of tournaments in the study of cycles in regular tournaments. However, at present, there seem to be only few known examples and constructions.
In this talk, we establish a connection between near-homogeneous tournaments and almost difference sets in combinatorial design theory. This result, together with a construction of almost difference sets by Ding, Helleseth and Lam (1999), provides a construction of a new family of near-homogeneous tournaments, which contains examples found by Astié-Vidal and Dugat (1990). Under a number-theoretic conjecture by Hardy and Littlewood (1923), we also confirm a conjecture by Savchenko (2016).

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

Masanori Sawa (Kobe Univ.) The construction theory of cubature formulas with applications to numerical analysis and statistics

September 23rd (Wed)

9:50–12:00

13 Kiyoshi Ando (Nat. Inst. of Information) Contractible edges in k-connected graphs with minimum degree greater than or equal to $\lfloor \frac{3k-1}{2} \rfloor$ ····· 15

Summary: Let G be a k-connected graph. An edge of G is said to be a k-contractible edge if the contraction of it results in a k-connected graph. We denote by $E_c(G)$ the set of k-contractible edges of G. We denote by $V(G)$ and $\delta(G)$ the set of vertices of G and the minimum degree of G, respectively. We prove that if $k \geq 3$, $|V(G)| \geq 2k+1$ and $\delta(G) \geq \lfloor \frac{3k-1}{2} \rfloor$, then $|E_c(G)| \geq |V(G)| + \lfloor \frac{5k-5}{2} \rfloor \lceil \frac{k}{2} \rceil - k$. We also show that this result is sharp.

14 Shinya Fujita (Yokohama City Univ.)
Sergey Kitaev (Univ. of Strathclyde)
Shizuka Sato (Yokohama City Univ.)
Li-Da Tong (Nat. Sun Yat-sen Univ.)
On properly ordered coloring of vertices in a vertex-weighted graph ····· 10

Summary: We introduce the notion of a properly ordered coloring (POC) of a weighted graph, that generalizes the notion of vertex coloring of a graph. Under a POC, if xy is an edge, then the larger weighted vertex receives a larger color; in the case of equal weights of x and y, their colors must be different. Further, for a graph G, we introduce the function $f(G)$ which gives the maximum number of colors required by a POC over all weightings of G. Another function we introduce is $\chi_{POC}(G;t)$ giving the minimum number of colors required over all weightings of G using t distinct weights.
In this talk, we present some results on this new parameter of a vertex-weighted graph.

15 Ronald J. Gould (Emory Univ.)
Kazuhide Hirohata (Ibaraki Nat. Coll. of Tech.)
Ariel Keller Rorabaugh (Univ. of Tennessee)
Vertex-disjoint chorded cycles and degree sum condition ····· 10

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

16 Naoki Matsumoto (Keio Univ.) On the difference between game chromatic number and chromatic number of graphs ····· 10

Summary: The *graph coloring game* on a graph G is a two-player game. In the game, they alternately color an uncolored vertex of G by a color in a given color set X so that any two adjacent vertices receive the different colors. The first player's aim is to completely color all vertices of G only by using colors in X, and the second player's aim is to avoid it. The *game chromatic number* of a graph G, denoted by $\chi_g(G)$, is the minimum number of colors such that Alice has a winning strategy for the graph coloring game on G. In this talk, we introduce our recent result that for any simple graph G, $\chi_g(G) - \chi(G) \leq \lfloor \frac{n}{2} \rfloor - 1$, where $\chi(G)$ is the chromatic number of G, where the estimation is best possible for any even n.

17 Kenta Noguchi (Tokyo Univ. of Sci.) Proper orientation number of planar graphs ····· 10

Summary: In this talk, we give some results about proper orientation number of planar graphs. Our main result is as follows: Let G be a bipartite planar graph with $\delta(G) \geq 3$. Then the proper orientation number of G is at most 3. Both of the bounds in this theorem are tight.

18 Shunichi Maezawa ♭ (Yokohama Nat. Univ.)
Kenta Ozeki (Yokohama Nat. Univ.) A forbidden pair for the existence of spanning k-trees in graphs ····· 15

Summary: For an integer $k \geq 2$, a *k-tree* is a tree with maximum degree at most k. A k-tree containing all vertices of a graph G is called a *spanning k-tree* of G. In 2010, Ota and Sugiyama gave a forbidden subgraph condition for a graph to have a spanning k-tree and they posed a conjecture that is stronger than their result. We solved their conjecture.

19 Toshiki Abe (Yokohama Nat. Univ.)
Kenta Ozeki (Yokohama Nat. Univ.)
Seog-Jin Kim (Konkuk Univ.) Alon–Tarsi number of K_5-minor-free graphs ····· 15

Summary: Alon–Tarsi number is one of the invariant of graphs and it is an upper bound of chromatic number, list chromatic number and painting number. In this talk, we will introduce the following three theorems and their applications. Let G be a K_5-minor-free graph. Then Alon–Tarsi number of G is at most 5, there exists a matching M of G such that the Alon–Tarsi number of $G - M$ is at most 4, and there exists a forest F such that the Alon–Tarsi number of $G - E(F)$ is at most 3.

20 Atsuhiro Nakamoto (Yokohama Nat. Univ.)
Fumiya Hidaka (Yokohama Nat. Univ.) Quadrangulations of a polygon with spirality ····· 15

Summary: A polygon P on the plane is a cycle with several straight segments. A quadrangulation of P is a geometric plane graph with vertex set $V(P)$ such that the outer cycle coincides with P and each inner face is quadrangular. In our talk, we discuss whether a given polygon P can be quadrangulated by adding edges to the interior of P, introducing the notion called "spirality".

21 Atsuhiro Nakamoto (Yokohama Nat. Univ.)
Daiki Ikegami (Yokohama Nat. Univ.) The number of diagonal flips in triangulations on closed surfaces ····· 15

Summary: In our talk, we prove that for any surface F^2, there exists an integer $N(F^2)$ such that any two n-vertex triangulations on F^2 can be transformed into each other by $O(n)$ diagonal flips, if $n \geq N(F^2)$. Moreover, we improve the known bound for $N(F^2)$.

September 24th (Thu)

9:00–12:00

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

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

23 Yasuaki Hiraoka (Kyoto Univ./RIKEN) Algebraic stability theorem for zigzag persistence modules · · · · · · · · · · · 15
Michio Yoshiwaki
(RIKEN/Kyoto Univ./Osaka City Univ.)

Summary: The algebraic stability theorem is an important part of the stability theorem in the theory of persistent homology and guarantees that the persistence diagram is stable with respect to small changes in the given persistence module. For purely zigzag persistence modules, an algebraic stability theorem also holds (Botnan and Lesnick). In contrast with their strategy, our strategy focuses on the equivalence of derived categories of ordinary and (not necessarily purely) zigzag persistence modules, and hence we derive an algebraic stability theorem for zigzag persistence modules from the ordinary ones. This enables us to obtain an algebraic stability theorem for the wider class than the result of Botnan and Lesnick. In this talk, we will discuss an algebraic stability theorem for zigzag persistence modules and its derived category.

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

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

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

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

26 Tatsuki Shimizu (Kyoto Univ.)[♭]
Yasuaki Hiraoka (Kyoto Univ.)
Limit theorems in the decomposition theory of multi-parameter persistent homology 15

Summary: In the decomposition theory of the multi-parameter persistence modules, which is a multidimensional version of the usual 1D persistence modules, there exists an algebraic difficulty unlike the 1D case. Rather than solving this difficulty purely algebraic, we attempt to tackle the difficulty probabilistically, that is, considering a scaling limit with an appropriate scale. As a first step, we have shown that there exists a scaling limit of rank invariant, and that of multiplicities of irreducible representations in a representation of a commutative ladder obtained from a point process.

27 Jun Miyanaga (Kyoto Univ.)
Yasuaki Hiraoka (Kyoto Univ.)
Shu Kanazawa (Kyoto Univ.)
Kenkichi Tsunoda (Osaka Univ.)
Large deviation principle for persistence diagrams of random cubical complex processes 15

Summary: Recently, multi-scale topological features of weighted higher-dimensional cubes, have been studied via persistence diagrams in various application fields such as digital image processing. In this talk we show a large deviation principle for the histograms generated by the average frequency densities on subdivision rectangles of persistence diagram. Furthermore, constructing a suitable projective limit using linear maps that average among the values on subdivisions rectangles, we show that the sequence of the histograms ordered by size of rectangle also satisfies a large deviation principle as elements in the projective limit.

28 Shu Kanazawa (Kyoto Univ.)
Law of large numbers for Betti numbers of random simplicial complexes 15

Summary: The Erdős–Rényi graph model has been extensively studied since the 1960s as a typical random graph model. Recently, the study of random simplicial complexes has drawn attention as a higher-dimensional generalization of random graphs. In this talk we introduce a class of homogeneous and spatially independent random simplicial complexes, and discuss the asymptotic behavior of their Betti numbers. This result extends the law of large numbers for Betti numbers of Linial–Meshulam complexes obtained in an earlier study by Linial and Peled. A key element in the argument is the local weak convergence of simplicial complexes. Inspired by the work of Linial and Peled, we establish the local weak limit theorem for homogeneous and spatially independent random simplicial complexes.

29 Tatsuya Mikami (Kyoto Univ.) First passage percolation on crystal lattices 15

Summary: First passage percolation (FPP) model is a time evolution version of the bond percolation model: each edge in the cubic lattice is assigned a random passage time, and consider the behavior of percolation region $B(t)$, which consists of the vertices that can be arrived from the origin within a time $t > 0$. Cox and Durrett (1981) showed the shape theorem for the region, saying that the normalized region $B(t)/t$ converges to some limit shape. The aim of this study is a generalization of the FPP model to the model formulated on general crystal lattices, and a general version of the shape theorem is obtained. A comparison of the limit shapes obtained from two crystal lattices with covering relation is also studied.

30 Emerson Gaw Escolar (RIKEN / Kyoto Univ.)
Yasuaki Hiraoka (Kyoto Univ.)
Mitsuru Igami (Yale Univ.)
Yasin Ozcan (MIT Sloan / FTI Consulting)
Mapping firms' locations in technological space: A topological analysis of patent statistics 15

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

31 Tomoki Uda (Tohoku Univ.) Interleaving distance on merge trees of grid data sublevelsets on different grid topologies 12

Summary: 0-dimensional persistent homology of a sublevelset filtration over a grid, called a merge tree, is useful in certain applications in image processing and topological flow data analysis. As it is well-kwown that stability holds true by interleaving distance, merge trees are robust to noises and hence in harmony with data analysis. However, there were no such concrete knowledge of how underlying grid topology affect a resulting merge tree. In this presentation I will show the upper bound estimate of interleaving distance of merge trees where underlying grid topologies vary under certain assumptions.

32 Masashi Wakaiki (Kobe Univ.) Robustness of strong stability with respect to sampling 15

Summary: We study the following question: "Suppose that an infinite-dimensional continuous-time system with a state-feedback controller is strongly stable. If we transform this continuous-time controller into a sampled-data controller by adding an idealized sample-and-hold process, will the resulting sampled-data system be strongly stable for all sufficiently small sampling periods?" We show that the answer of this question is "yes" under certain assumptions, by using the so-called Arendt–Batty–Lyubich–Vu theorem.

14:15–16:30

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

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

Summary: Most studies on projection methods, which are numerical schemes for solving the time-dependent Navier–Stokes equation, deal with Dirichlet boundary conditions for the velocity and Neumann ones for the pressure on the whole boundary. However, boundary conditions involving the pressure are important for real-world applications. We propose new projection methods with the pressure boundary conditions and show the stability for the solution to the schemes and establish error estimates in suitable norms.

Summary: The hypercircle method and the idea of Kato–Fujita's method are applied to develop a point-wise error estimation for FEM solutions to boundary value problems. It is shown that one can give explicit lower and upper bound for the solution value at an interior point with an $O(h^2)$ convergence rate.

Summary: Discontinuous Galerkin (dG, in short) methods are extensions of usual (Ritz–)Galerkin finite element methods that are much more flexible on meshes to use. However, when we deal with dG methods, we must impose the shape-regularity condition on meshes for both theoretical error analysis and practical computations. In this paper, we present a new symmetric interior penalty discontinuous Galerkin scheme with a modified penalty term. We show that, without imposing the shape-regularity condition on meshes, the new dG scheme inherits all good properties from the standard dG methods. Numerical experiments confirm the theoretical error estimates obtained.

Summary: We propose a method of fundamental solutions (MFS) for the problem of two-dimensional potential flow past a doubly-periodic array of obstacles. It is difficult to apply the conventional MFS to this problem because the solution involves a doubly-periodic function. We propose a new type of MFS, where the solution is approximated by a linear combination of the periodic fundamental solutions expressed by the complex logarithmic functions and the theta functions. Numerical examples show the effectiveness of our method.

Summary: We deal with a nonlinear nonlocal Fokker–Planck type equation, which appears in various fields of application. The equation has some properties; the property of mass conservation, non-negativity, boundedness and the energy-dissipation property. In this talk, we introduce and analyze a numerical scheme that preserves these properties at the discrete level.

Summary: In this talk we describe some numerical verification procedures to prove the invertibility of a linear operator in Hilbert spaces and to compute a bound for the norm of its inverse. These approaches improve on previous procedures that use an orthogonal projection of the Hilbert space and its a priori error estimations. Several verified examples which confirm the effectiveness of the new procedures are presented.

40 Takehiko Kinoshita (Kyushu Univ.)
Kouji Hashimoto (Nakamura Gakuen Univ.)
Mitsuhiro T. Nakao (Waseda Univ.)
On the decreasable effect of wrapping effect using a priori estimates separating initial values in the verification probrem for parabolic equations 15

Summary: The verification procedures of solutions for initial value problem have an expanding phenomenon of varidated area called wrapping effect. We will propose a new verification procedure of solutions for parabolic initial-boundary value problem to reduce wrapping effect using a priori estimates separating the heat equation with initial values and the shifted equation without initial values.

16:45–17:45 Talk Invited by Applied Mathematics Section

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

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

September 25th (Fri)

9:00–11:45

41 Nobito Yamamoto (Univ. of Electro-Comm.)
Koki Nitta (Univ. of Electro-Comm.)
Construction of local Lyapunov functions around non hyperbolic equilibria by verified computation 15

Summary: We propose new methods to construct local Lyapunov functions around non-hyperbolic equilibria using verified computation. The methods are based on the normal form theory in dynamical systems.

42 Shinya Uchiumi (Gakushuin Univ.)
Guaranteed bounds for the eigenvalues of Laplacian in curved domains 15

Summary: We consider the eigenvalue problem of the Laplacian with the homogeneous Dirichlet boundary condition, or homogeneous Neumann condition, in curved domains. Based on the theorem by Liu and Oishi, we show guaranteed bounds of the eigenvalues, where the lower and upper bounds are explicitly computable. We use the curved finite element space by Zlámal. The constant that appears in the theorem by Liu and Oishi is estimated by using the argument by Ciarlet and Raviart.

43 Akitoshi Takayasu (Univ. of Tsukuba)
Jonathan Jaquette (Boston Univ.)
Homoclinics and global existence of solutions to a quadratic nonlinear Schrödinger equation 15

Summary: In this talk, we show global existence of solutions to a quadratic nonlinear Schrödinger equation. For the nonliear Schrödinger equation without Gauge-invariance global existence of solutions is less apparent due to the lack of conserved quantities. By using a scaling technique based on a solution of ordinary differential equations, our main theorem gives a sufficient condition of global existence of such a solution. The proof is obtained by rigorous numerics, via rigorous numerical integration of the solution and validating the sufficient condition based on interval arithmetic.

Summary: In this talk, we introduce positivity preserving numerical method based on Ito's formula. In this abstract, we only denote our idea for 1 dimensional problems, but our ideas can easily be extended to multi-dimensional problems.

Summary: In this talk, we mainly compare the structures of ResNet and DenseNet with a view to systematically understand the skip connection which is one of the structure of the model. As a result, it was theoretically confirmed that it is only due the regularity of full connected layers that gives differences in the expressive power of both models.

Summary: Recently, methods for learning differential equation models from data using neural networks have been actively studied. In this talk, we propose a theoretical framework for the analysis of the influence of numerical integrators that are used to discretize the differential equation model in learning.

Summary: We are concerned with vortex dynamics on the surface of a torus. Although the flows on the surface of a torus is no longer a physical relevance to real fluid flow phenomena, it is theoretically interesting to observe whether the geometric nature of the torus, i.e., a compact, orientable 2D Riemannian manifold with non-constant curvature and one handle, yields different vortex dynamics that are not observed so far. In this presentation, we show two equilibrium states of vortex structures. One is called vortex crystals, in which point vortices are moving in the longitudinal direction without changing their relative configuration. Another one is an exact analytic solution of a modified Liouville equation on the toroidal surface, which is known as Stuart vortex.

Summary: The Jeans instability is a key concept that facilitates our understanding of galaxy and star formation in astrophysics. To understand this dynamics, we consider the dynamics of the three-dimensional compressible Navier–Stokes–Poisson system.

Summary: In this presentation, we consider a distributed delay differential equation. It has been shown that there exists a periodic solution with a minimum period of 2 for a certain type of equations. We study the delay differential equation when the nonlinear function is given by a step function. Convergence of the solution to the periodic solution and the existence the periodic solutions are studied.

50 Tetsuya Ishiwata (Shibaura Inst. of Tech.) ♭
Alexey Eremin (Saint Petersburg State Univ.)
Emiko Ishiwata (Tokyo Univ. of Sci.)
Yukihiko Nakata (Aoyama Gakuin Univ.)
Stability of periodic solutions to 2 dimensional delay differential equation 10

Summary: We discuss 2 dimensional delay differential equation with a constant delay. This system has blow-up solutions and infinitely many periodic solutions. In this talk, we show the stability of these periodic solutions.

51 Mikio Murata (Tokyo Univ. of Agri. and Tech.)
Analysis of Turing instability in max function type diffusion cellular automata 15

Summary: As basic cellular automata that express the reaction-diffusion phenomenon, we proposed "max function type diffusion cellular automata". In this presentation, we give the definition of Turing instability in the max function type diffusion cellular automata and analyze the Turing instability of the max function type diffusion cellular automata. In addition, we discuss the similarities and differences with the Turing instability of the reaction-diffusion equation.

14:15–15:15

52 Itsuki Watanabe (Waseda Univ.)
Limit theorems for a space-homogeneous nonlocal diffusion with nonlinear reactions 15

Summary: We discuss the difference of two mathematical models of nonlocal diffusion; the deterministic and stochastic models. The deterministic model is given by a nonlinear reaction-diffusion equation, and the stochastic model is given by a multi-dimensional jump Markov process. In this talk, we show two convergence theorems. First, we prove that the difference of two models converges to 0 in probability. Second, we consider the rescaled difference and prove that it converges to some stochastic process in distribution on the Skorokhod space.

53 Ken-Ichi Nakamura (Kanazawa Univ.)
Masahiro Hiyoshi (Kanazawa Univ.)
Takafumi Yamazaki (Kanazawa Univ.)
Speed of traveling waves for discrete bistable Lotka–Volterra competition system 15

Summary: We study a Lotka–Volterra competition-diffusion system with bistable nonlinearity in which the habitat is divided into discrete niches. We derive a condition that the propagation failure phenomenon occurs. We also derive sufficient conditions for the existence of traveling waves with nonzero speed. By these results, we can predict which species will become dominant and win the competition.

54 Yasumasa Nishiura (Hokkaido Univ.*)
Shuangquan Xie (Tohoku Univ.)
Theodore Kolokolnikov (Dalhousie Univ.)
Complex oscillatory motion of multiple spikes for a three-component Schnakenberg model 15

Summary: We introduce a three-component Schnakenberg model. A key feature is that it has a solution consisting of N spikes that undergoes a Hopf bifurcation with respect to N distinct modes nearly simultaneously. This results in complex oscillatory dynamics of the spikes, not seen in typical two-component models. We derive a reduced equations of motion which consist of coupled ordinary differential equations of order 2N around Hopf bifurcation points. We also apply the method of multiple scales to the resulting ODEs to derive a long-time dynamics. For instance, the coexistence of stable in-phase and out-of-phase modes, which does not occur for two-component systems, is observed for two-spike case. Further away from the Hopf bifurcation points, we observe numerically a variety of highly complex oscillatory modes including chaotic motions.

Summary: We construct a mathematical model for a butyl salicylate (BS) droplet motion to clarify the emergence mechanism for the mode-change of a droplet motion depending on the surfactant concentration in the water phase. Our model is composed of reaction-diffusion equations for a sodium dodecyl sulfate (SDS), BS, and the mixture of SDS and BS, and an equation on motion for the BS droplet. Features of reciprocation and mode-change depending on the concentration of SDS are qualitatively reproduced by numerical calculation based on an equation of motion and the kinetics of SDS and BS at the air/aqueous interface.

15:30–16:30 Talk Invited by Applied Mathematics Section

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

Topology

September 22nd (Tue)

10:00–12:00

1 Ryo Hanaki (Gifu Univ.) On fertility of knot shadows 10

Summary: A knot K is a parent of a knot H if there exists a minimal crossing diagram D of K such that a subset of the crossings of D can be changed to produce a diagram of H. A knot K with crossing number n is fertile if for any prime knot H with crossing number less than n, K is a parent of H. We introduce fertile for a knot shadow which is a diagram without over/under information at all crossings. We show that if an alternating knot K is fertile then the crossing number of K is less than eight.

2 Naoko Kamada (Nagoya City Univ.) Almost classical virtual links 10

Summary: Classical link diagrams admit Alexander numberings. However some virtual link diagrams do not admit Alexander numberings. If a virtual link diagram admits an Alexander numbering, it is said to be almost classical. A virtual link is almost classical if it has an almost classical virtual link diagram. In this talk, we introduce a map from the set of virtual link diagrams to that of almost classical virtual link diagrams. This map induces a map from the set of virtual links to that of almost classical virtual links.

3 Yoshiyuki Ohyama (Tokyo Woman's Christian Univ.)
Migiwa Sakurai (Shibaura Inst. of Tech.)
A construction of infinitely many virtual knots with properties of Kishino's knot 10

Summary: Satoh and Taniguchi defined a virtual knot invariant J_n called the n-writhe for each non-zero integer n. The n-writhes give the coefficients of some polynomial invariants for virtual knots including the index polynomial, the odd writhe polynomial and the affine index polynomial. It is obvious that the virtualization of a real crossing is an unknotting operation for virtual knots. The unknotting number by the virtualization is called the virtual unknotting number. Kishino's knot is a virtual unknotting number one knot which has the trivial n-writhes and the trivial Jones polynomial. In this talk, we construct infinitely many virtual knots with the same properties as Kishino's knot. By using the Miyazawa polynomial, we showed that these virtual knots are non-trivial and non-classical, and their knot types are all different.

4 Haruko Miyazawa (Tsuda Coll.)
Kodai Wada (Osaka Univ.)
Akira Yasuhara (Waseda Univ.)
The Dabkowski–Sahi invariant and 4-moves for links 10

Summary: Dabkowski and Sahi defined an invariant of a link in the 3-sphere, which is preserved under 4-moves. This invariant is a quotient of the fundamental group of the complement of the link. It is generally difficult to distinguish the Dabkowski–Sahi invariants of given links. In this talk, we give a necessary condition for the existence of an isomorphism between the Dabkowski–Sahi invariant of a link and that of the corresponding trivial link. Using this condition, we provide a practical obstruction to a link to be trivial up to 4-moves.

5 Atsuhiko Mizusawa (Waseda Univ.)
Yuka Kotorii (RIKEN/Osaka Univ.)
An algorithm which determine whether given two 4-component links are link-homotopic 15

Summary: We give an algorithm to determine whether given two 4-component links are link-homotopic or not via the clasper theory. This algorithm is a translation of Habegger and Lin's algorithm. We describe actions of partial conjugates to 4-component string links explicitly.

6 Ippei Ishii
Takuji Nakamura (Univ. of Yamanashi)
Toshio Saito (Joetsu Univ. of Edu.)
A coloring invariant of 3-manifolds derived from flow spines and virtual knot diagrams 10

Summary: Let M be a closed, oriented, connected 3-manifold. Considering the homotopy class of its non-singular vector field, we obtain a flow spine of M and, furthermore, construct a virtual knot diagram from the flow spine. This talk introduces a coloring invariant of 3-manifolds by using their virtual knot diagrams. Our invariant distinguishes the Poincaré homology sphere from the 3-sphere.

7 Kazuhiro Ichihara (Nihon Univ.)
Toshio Saito (Joetsu Univ. of Edu.)
In Dae Jong (Kindai Univ.)
Thomas W. Mattman
(California State Univ., Chico)
Two-bridge knots admit no purely cosmetic surgeries 15

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

8 Yasuharu Nakae (Akita Univ.)
Kazuhiro Ichihara (Nihon Univ.)
Dehn surgeries on genus one fibered knots and left-orderability of fundamental groups 15

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

9 Takefumi Nosaka (Tokyo Tech)
Cellular chain complexes of universal covers of some 3-manifolds 10

Summary: We consider a class of closed 3-manifolds, which satisfies "Property (†)". For a 3-manifold M in this class, we give a presentation of the cellular chain complexes of the universal covers of M. The class includes all surface bundles, some surgeries of knots in S^3, some cyclic branched cover of S^3, and some Seifert manifolds. As an application, we establish a formula for calculating the linking form of a cyclic branched cover of S^3.

10 Takefumi Nosaka (Tokyo Tech)
An $SL_2(\mathbb{R})$-Casson invariant and Reidemeister torsions 15

Summary: We define an $SL_2(\mathbb{R})$-Casson invariant of closed 3-manifolds. Moreover, we describe a procedure for computing the invariant in terms of a Reidemeister torsion and discuss approaches to giving the Casson invariant some gradings.

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

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

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

September 23rd (Wed)

10:00–11:40

11 Genki Omori (Tokyo Univ. of Sci.)
Naoki Sakata (Saitama Univ.)
Dehn twist-crosscap slide presentations for involutions on non-orientable surfaces of genus 4 and 5 ····· 15

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

12 Yuta Nozaki (Hiroshima Univ.)
Masatoshi Sato (Tokyo Denki Univ.)
Masaaki Suzuki (Meiji Univ.)
Abelian quotients of the Y-filtration on the homology cylinders via the LMO functor ····· 15

Summary: We construct a series of homomorphisms on the Y-filtration on the homology cylinders via the mod $\mathbb{Z}$ reduction of the LMO functor. The restriction of our homomorphism to the lower central series of the Torelli group does not factor through Morita's refinement of the Johnson homomorphism. We use it to show that the abelianization of the Johnson kernel of a closed surface has torsion elements. This is the joint work with Masatoshi Sato and Masaaki Suzuki.

13 Masaki Taniguchi (RIKEN) ♭
Codimension-1 embeddings of 3-manifolds and Yang–Mills gauge theory ····· 15

Summary: We give a relation between existence of an embedding of a 3-manifold into a 4-manifold X and existence of an irreducible SU(2)-representation of the fundamental group of X. For example, we can prove the following result: Let X be a closed oriented definite 4-manifold containing the Poincare homology 3-sphere as a submanifold. Then the fundamental group of X admits at least four irreducible SU(2)-representations. Since the Poincare homology 3-sphere has a (topological) locally flat embedding into the 4-space, the above result can not be proved in the topological category. The proof uses a quantitative formulation of instanton Floer homology.

14 Nobutaka Asano (Tohoku Univ.)
Vertical 3-manifolds in simplified genus 2 trisections of 4-manifolds ··· 15

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

15 Kengo Kawamura (Kogakuin Univ.)
Spinning construction of immersed 2-knot and its irreducibility ····· 10

Summary: Using a certain spinning construction producing immersed 2-knots, we give an infinite family of irreducible immersed 2-knots with one self-intersection point.

16 Tetsuya Abe (Ritsumeikan Univ.) ♭
Keiji Tagami (Nat. Fisheries Univ.)
Table of annulus presentations of knots ····· 10

Summary: In this talk, we determine which knots have special annulus presentations of knots up to 8-crossings. We also give explicit pictures of special annulus presentations of knots up to 8-crossings.

17 Seiichi Kamada (Osaka Univ.) On knotted surfaces as vanishing sets of polynomials 10
Benjamin Bode (Osaka Univ./JSPS)

Summary: This is an announcement of the results of the paper "Knotted surfaces as vanishing sets of polynomials", arXiv: 2004.02468. We provide an algorithm that constructs for any element B of the loop braid group a polynomial $f : \mathbf{R}^5 \to \mathbf{R}^2$ such that the vanishing set $f^{-1}(0) \cap S^4$ on the unit 4-sphere contains a set that is ambient isotopic to the closure of B. We also provide an algorithm that constructs for any spinning braid B in $\mathbf{C} \times S^1 \times S^1$ there exists a holomorphic polynomial $f : \mathbf{C}^3 \to \mathbf{C}$ such that $f^{-1}(0) \cap (\mathbf{C} \times S^1 \times S^1)$ is ambient isotopic to B. Our algorithms also provide an upper bound on the degree of f.

18 Seiichi Kamada (Osaka Univ.) On doodles and commutator identities 10
Andrew Bartholomew (Univ. Sussex)
Roger Fenn (Univ. Sussex)
Naoko Kamada (Nagoya City Univ.)

Summary: This is an announcement of our paper "Doodles and commutator idintities".
A doodle diagram is a collection of immersed circles in the 2-sphere whose multiple points are transverse double points. A colored doodle diagram with a noose system determines a commutator identity (an identity among commutators). We discuss doodles with proper noose systems and elementary commutator identities. In particular we show that there is a bijection between cobordism classes of colored doodles and weak equivalence classes of elementary commutator identities.

13:15–14:15 Award Lecture for the 2020 MSJ Geometry Prize

Mikiya Masuda (Osaka City Univ.)♭ Cohomological rigidity problem in toric topology

Summary: A toric variety is a normal complex algebraic variety with an algebraic action of a C*-torus having an open dense orbit. The fundamental theorem in toric geometry says that there is a one-to-one correspondence between toric varieties and fans. Among toric varieties, compact smooth toric varieties, which we call toric manifolds, are well understood. For instance, their cohomology rings and Chern classes are explicitly described in terms of the associated fans. The classification of toric manifolds as varieties reduces to the classification of the associated fans. However, the classification of toric manifolds as smooth manifolds is not well understood. Related to this, the author and Dong Youp Suh posed the following problem in 2008.
Cohomological rigidity problem (for toric manifolds). Are toric manifolds diffeomorphic (or homeomorphic) if their cohomology rings with integer coefficients are isomorphic as graded rings?
Many partial affirmative solutions to the problem have been obtained but no counterexamples are known so far. There are several analogues of the problem and two of them are a symplectic analogue and a real analogue. The former is related to McDuff's question on the uniqueness of a toric structure on a monotone symplectic manifold and the latter is related to flat Riemannian manifolds and hyperbolic 3-manifolds of Loebell type. In this talk, I will overview some development on these problems.

September 24th (Thu)

10:00–11:55

19 Takamichi Sato (Waseda Univ.) Isomorphism between the stabilizers of finite sets of numbers in the R. Thompson group F 15

Summary: Let H_U be the subgroups of the R. Thompson group F that are stabilizers of finite sets U of numbers in the interval $(0, 1)$ under the natural action of F on $(0, 1)$. In this talk we give a necessary and sufficient condition for H_U and H_V to be isomorphic for finite sets U and V.

Summary: Suppose that an ideal J of C^∞ functions on an open subset of $\mathbf{R}^2$ is a Łojasiewicz ideal. We describe the set of C^∞ functions vanishing on the zeros of J explicitly using J in an open neighborhood of each point in zeros of J, it can be obtained by taking real radical and closure starting from J repeatedly for a finite number of times. This gives an another affirmative answer to Bochnak's conjecture in dimension 2, which is first done by Risler.

Summary: Let X be a metric measure space which satisfies the following conditions: 1. X is separable and locally compact, 2. all Borel subsets of X are measurable and for any measurable set $E \subset X$, there exists a Borel set $B \subset X$ such that $E \subset B$ and $B \setminus E$ is a null set, 3. each non-empty open set $U \subset X$ has positive measure, 4. every compact set $K \subset X$ has finite measure, 5. $X \setminus \{x \in X \mid \{x\}$ is measurable and null$\}$ is not dense in X. In this talk, we shall show that the space of real-valued uniformly continuous functions on X with the L^p norm, $1 \leq p < \infty$, is homeomorphic to the subspace consisting of sequences conversing to 0 in the pseudo interior.

Summary: Closed and simply-connected differentiable manifolds are central geometric objects in classical differential topology. They were classified via algebraic and abstract objects, thanks to the assumption that the dimensions are sufficiently high. However, due to this it is difficult to understand them in geometric and constructive ways. In this talk, we will show a related study via construction of Morse functions and fold maps, which are higher dimensional versions of Morse functions. We present infinitely many 7-dimensional closed and simply-connected manifolds and explicit fold maps into the 4-dimensional Euclidean space. Note that since the discovery of exotic spheres by Milnor in 1956, the class of 7-dimensional closed and simply-connected manifolds has been an attractive class for a long time.

Summary: On symplectomorphism groups of the disk, we construct two homogeneous quasi-morphisms which relate to the Calabi invariant and the flux homomorphism respectively. We also give the relation between the quasi-morphisms and Poincaré's rotation number.

Summary: We introduced obstruction classes for the simplicial bundle of homotopy algebra models associated with a fiber bundle. It is an invariant for a fiber bundle. On the other hand, it is known that these exists a certain inequality for Euler class of flat bundles. In our research, we attempt to prove such an inequality for our obstruction class. In this presentation, we present this attempt and some results.

Summary: Haefliger characterized taut foliations in terms of so-called Haefliger cohomology. We show that Haefliger cohomology characterizes strongly tense foliations, namely, foliated manifolds which admit a Riemannian metric such that the mean curvature form of the leaves is closed and basic. We show that Haefliger cohomology is dual to invariant cohomology for complete Riemannian foliations. As an application of these results, we prove that any complete Riemannian foliation is strongly tense, which is a generalization of Dominguez's tenseness theorem for Riemannian foliations on closed manifolds.

Summary: The real Johnson–Wilson theory is a general homology theory, established by Hu–Kriz and Kitchloo–Wilson. It is not complex-oriented theory and is the higher analogue of real K-theory. The coefficient groups have been determined by Hu–Kriz and now we know that it has rich structures. It is important since it is expected to have rich information about the homotopy groups of spheres, for example. In this talk, we will announce the results on the real Johnson–Wilson homology groups of small spectra, each of which has a few cells.

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

Alexander Berglund (Stockholm Univ.)♭ Characteristic classes of manifold bundles and graph homology

Summary: We introduce new families of rational characteristic classes of manifold bundles associated to homology classes in a certain graph complex.

More precisely, we consider bundles of simply connected spaces where the fiber is a closed oriented manifold and the structure group is the group of diffeomorphisms of the fiber that fix an embedded disk. The graph complex we consider is closely related to the Feynman transform of the Lie operad, the homology of which is known to be expressible in terms of the homology of automorphism groups of free groups.

The new classes may be viewed as a generalization of the Miller–Morita–Mumford classes; we show that these may be recovered from zero dimensional graph homology. We also show that the new classes provide a better understanding of the calculation of the stable rational cohomology of the block diffeomorphism group of the manifold $\sharp^g S^d \times S^d$ (the g-fold connected sum of $S^d \times S^d$) due to Ib Madsen and myself.

Infinite Analysis

September 22nd (Tue)

9:30–12:00

Summary: We will present a certain discrete dynamical system defined on an integer lattice. The system have the coprimeness property, which is an algebraic analogue of the singularity confinement, while it is non-integrable in terms of exponential degree growth. The system can be regarded as an extension to the Hietarinta–Viallet type equation. We will derive (or conjecture for some cases) the algebraic entropies of the equations which is obtained by reductions from the system. This presentation is based on a joint work in a preprint arXiv: 1812.08923.

Summary: It is a natural question to ask when discrete versions of integrable systems are themselves integrable. This question has led to very active and productive searches for partial difference equations that have properties closely related to those of integrable PDEs, such as the Korteweg–de Vries equation. Recent results have focused on partial difference equations given by polynomial equations placed in a consistent way on faces of cubes, which turn out to have the desired integrability properties. In this talk, we show an extension of this search to cuboctahedra.

Summary: We study asymptotic expansion of the third q-Painlevé equation ($A_3^{(1)}$) around the origin. We also study the connection matrix corresponding the Lax pair of the third q-Painlevé equation.

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

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

6 Masashi Hamanaka (Nagoya Univ.)
Claire Gilson (Univ. of Glasgow)
Shan-Chi Huang (Nagoya Univ.)
Jonathan Nimmo (Univ. of Glasgow)
Soliton solutions of noncommutative anti-self-dual Yang–Mills equations 15

Summary: We present exact soliton solutions of anti-self-dual Yang–Mills equations for $G = GL(N)$ on noncommutative Euclidean spaces in four-dimension by using the Darboux transformations. Generated solutions are represented by quasideterminants of Wronski matrices in compact forms. We give special one-soliton solutions for $G = GL(2)$ whose energy density can be real-valued. We find that the soliton solutions are the same as the commutative ones and can be interpreted as one-domain walls in four-dimension. Scattering processes of the multi-soliton solutions are also discussed.

7 Masashi Hamanaka (Nagoya Univ.)
Shan-Chi Huang (Nagoya Univ.)
Soliton solutions of domain-wall type to anti-self-dual Yang–Mills equations 15

Summary: We study exact soliton solutions of anti-self-dual Yang–Mills equations for $G = GL(2)$ in four-dimensional spaces with the Euclidean, Minkowski and Ultrahyperbolic signatures and construct special kinds of one-soliton solutions whose action density (Lagrangian density) can be real-valued. These solitons are shown to be new type of domain walls (not instantons) in four dimension by explicit calculation of the real-valued action density. Our results are successful applications of the Darboux transformation developed by Nimmo, Gilson and Ohta. More surprisingly, integration of these action densities over the four-dimensional spaces would not be infinity but zero. Furthermore, whether gauge group $G = U(2)$ can be realized on our solition solutions or not is also discussed on each real space.

8 Saburo Kakei (Rikkyo Univ.)
Toda lattice hierarchy and soliton equations on square lattice 15

Summary: Lattice soliton equations of KdV-family and Boussinesq-family are investigated from the viewpoint of the Toda lattice hierarchy. As a consequence, special solutions such as soliton solutions and algebro-geometric solutions are constructed in a unified manner.

14:30–16:30

9 Nicolas Babinet (Univ. de Bourgogne)
Taro Kimura (Univ. de Bourgogne)
Quantum curve for supermatrix model and Hirota differential equations 15

Summary: We quantize the spectral curve appearing in the saddle point analysis of the supermatrix model. We show that the Hirota bilinear equation is obtained as a quantum curve equation instead of the usual ODE. In particular for the Gaussian case, it is identified with that for the Painlevé IV τ function in Noumi–Yamada's symmetric form.

10 Hiraku Nakajima (Univ. of Tokyo)
Euler numbers of Hilbert schemes of points on simple surface singularities and quantum dimensions of standard modules of quantum affine algebras 15

Summary: We prove the conjecture by Gyenge, Neḿethi and Szendrői in arXiv:1512.06844, arXiv:1512.06848 giving a formula of the generating function of Euler numbers of Hilbert schemes of points $\mathrm{Hilb}^n(\mathbb{C}^2/\Gamma)$ on a simple singularity $\mathbb{C}^2/\Gamma$, where Γ is a finite subgroup of $SL(2)$. We deduce it from the claim that quantum dimensions of standard modules for the quantum affine algebra associated with Γ at $\zeta = \exp(2\pi i/2(h^\vee + 1))$ are always 1, which is a special case of a conjecture by Kuniba [Kun93]. Here $h^\vee$ is the dual Coxeter number. We also prove the claim, which was not known for E7, E8 before.

11 Hiromu Nakano (Tohoku Univ.)[♭]
The structure theorem of Fock modules at positive rational level 15

Summary: We study structure of Fock modules at positive rational level. Using deformation theory constructed by Tuschiya–Wood and Shiraishi's theorem for singular vectors of Fock modules, we proved the structure theorem of Fock modules without Jantzen Filtration.

12 Yuma Mizuno (Tokyo Tech)♭ Difference equations arising from cluster algebras ····· 15

Summary: We characterize Y/T-system type difference equations arising from cluster algebras by triples of matrices, which we call T-data, that have a certain symplectic property. We show that all mutation loops are essentially obtained from T-data, which generalizes the general solution for period 1 quivers given by Fordy and Marsh.

13 Yasuaki Gyoda (Nagoya Univ.) Compatibility degree of cluster complexes ····· 15

Summary: I will introduce a new function on the set of pairs of cluster variables, which we call it the compatibility degree (of cluster complexes). The compatibility degree which I deal with in this talk is a generalization of the "classical" compatibility degree introduced by Fomin and Zelevinsky. The classical one defines the generalized associahedra, and it is used to give the classification of cluster algebras of finite type. Cao and Li generalized this degree to that of cluster complexes by using d-vectors. We give another generalization by using f-vectors on the basis of their studies. This is joint work with Changjian Fu.

14 Yuta Nishiyama (Kumamoto Univ.) Inner products of Macdonald polynomials and its combinatorics ····· 15

Summary: The Macdonald polynomials are a family of symmetric polynomials indexed by partitions. By calculating the inner product of the Macdonald polynomials corresponding to the partition (1^n), one obtains an identity of two parameters. In this talk, we introduce its proof through constructing certain bijections by transforming the Young diagrams of partitions. We also introduce similar identities obtained from inner products of other symmetric polynomials.

September 23rd (Wed)

10:30–11:30 Talk Invited by Infinite Analysis Special Session

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

Summary: $\imath$quantum groups are generalizations of quantum groups appearing as one-sided coideal subalgebras of quantum groups in the theory of quantum symmetric pairs. Representation theory of $\imath$quantum groups play important roles in various branches of mathematics and mathematical physics such as harmonic analysis, integrable system, low-dimensional topology, and categorification. Recently, many results which we should call "$\imath$quantization" have been reported. $\imath$quantizations have two meanings; (1) generalizing what is known for usual quantum groups to $\imath$quantum groups, (2) quantizing what is known for classical Lie algebras but cannot be quantized by usual quantum groups, by means of $\imath$quantum groups. In this talk, I introduce examples of $\imath$quantizations such as canonical basis, geometric construction, Hall algebraic construction, Gelfand–Tsetlin basis of type B/D, Schur duality of type B/C/D, highest weight theory, canonical basis, and crystal basis.

13:15–14:15 Talk Invited by Infinite Analysis Special Session

Yoshihisa Saito (Rikkyo Univ.)♭ On elliptic Artin groups

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

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

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