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The Mathematical Society of Japan

2019 Annual Meeting

Titles and Short Summaries of the Talks

March, 2019

at Tokyo Institute of Technology

2019 The Mathematical Society of Japan

ANNUAL MEETING

Dates: March 17th (Sun)–20th (Wed), 2019

Venue: Ookayama Campus, Tokyo Institute of Technology
2–11–1 Ookayama, Meguro-ku,
Tokyo 152-8551 Japan

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	I West Bldg. 2 W241	II West Bldg. 3 W351	III West Lec. 1 W521	IV West Lec. 1 W531	V West Lec. 1 W541	VI West Lec. 2 W611	VII West Lec. 2 W621	VIII West Lec. 2 W631	IX West Lec. 2 W641
17th (Sun)	Applied Mathematics 9:00–12:10 14:15–16:55	Complex Analysis 9:45–11:50 14:15–15:20	Functional Equations 9:15–12:00 14:15–16:15	Algebra 9:15–11:45	Geometry 9:40–11:40 14:20–16:25	Found. of Math. & Hist. of Math. 9:00–10:55 14:15–17:40	Topology 9:45–12:00 14:15–15:05	Statistics and Probability 9:30–12:00 14:15–15:05	Functional Analysis 10:30–12:00 14:15–16:00
	Featured Invited Talks 13:00–14:00								
	Invited Talk 17:00–18:00	Invited Talk 15:35–16:35	Invited Talk 16:30–17:30	Invited Talks 14:15–15:15 15:30–16:30	Invited Talk 16:40–17:40	Invited Talk 11:00–12:00	Invited Talk 15:20–16:20	Invited Talks 15:20–16:20 16:40–17:40	Invited Talk 16:15–17:15
18th (Mon)	Applied Mathematics 9:10–12:10	Complex Analysis 9:45–11:45	Functional Equations 9:15–12:00	Algebra 9:40–12:00 13:15–14:15	Geometry 9:50–11:40 Geometry & Topology	Found. of Math. & Hist. of Math. 9:00–11:50	Topology 9:30–11:50	Statistics and Probability 10:00–11:20	Functional Analysis 9:00–12:00
	Invited Talk 13:15–14:15	Invited Talk 13:15–14:15	Invited Talk 13:15–14:15		Invited Talk 13:15–14:15	Invited Talk 13:15–14:15			Invited Talk 13:15–14:15
	MSJ Prizes Presentation (70th Anniversary Auditorium) ····· (14:45–15:20) Plenary Talks (70th Anniversary Auditorium) Spring Prize Winner ····· (15:30–16:30) Shyuichi Izumiya (Hokkaido Univ.*) ····· (16:45–17:45) Official Party (Royal Blue Hall, Tokyo Tech Front) ····· (18:00–20:00)								
19th (Tue)	Applied Mathematics 9:20–11:45 14:20–16:30	Real Analysis 9:00–12:00 15:30–16:50	Functional Equations 9:00–12:00 14:15–16:15	Algebra 9:20–12:00 14:15–15:05	Geometry 9:40–11:40 14:20–16:25	Infinite Analysis 10:00–11:45	Topology 9:00–11:50 14:15–15:05	Statistics and Probability 9:45–12:00 14:15–15:00	Functional Analysis 9:00–12:00 14:15–15:45
	Featured Invited Talks 13:00–14:00								
	Invited Talk 16:40–17:40	Invited Talks 14:15–15:15 17:00–18:00	Invited Talk 16:30–17:30	Invited Talks 15:35–16:35 16:45–17:45	Invited Talk 16:40–17:40	Invited Talks 14:15–15:15 15:30–16:30	Invited Talk 15:20–16:20	Invited Talks 15:20–16:20 16:40–17:40	Invited Talk 16:00–17:00
20th (Wed)	Applied Mathematics 9:20–11:50	Real Analysis 9:00–11:50 14:15–15:05	Functional Equations 9:00–12:00 14:15–16:15	Algebra 9:10–12:00 14:15–15:40		Infinite Analysis 10:00–11:45		Statistics and Probability 9:30–12:00 14:15–16:00	
	Featured Invited Talks 13:00–14:00								
		Invited Talk 15:20–16:20	Invited Talk 16:30–17:30						

Contents

Plenary Talks

March 18th (Mon) 70th Anniversary Auditorium

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

Shyuichi Izumiya (Hokkaido Univ.*) Geometric equivalence among smooth map germs —an homage to the Thom–Mather theory— ..... (16:45–17:45)

Summary:

In the history of the theory of singularities of smooth mapping, the notion of $\mathcal{A}$-equivalence (i.e. right-left equivalence or isomorphism) among smooth map germs in the sense of Mather is the most natural equivalence from the view point of differential topology. In order to solve the structural stability problems of Thom, Mather (around 1970) also introduced the notion of $\mathcal{K}$-equivalence, which played a key role in his theory. We remark that map germs can be considered as local sections of trivial (vector) bundles and $\mathcal{K}$-equivalence is naturally interpreted as an equivalence relation among section germs of a vector bundle.

In this talk, we consider the case when the target space or the corresponding vector bundle have geometric structures. Firstly, we consider equivalence relations among smooth map germs with respect to G-structures on the target space germ. These equivalence relations are natural generalization of $\mathcal{A}$-equivalence depending on geometric structures on the target space germ. Unfortunately, these equivalence relations are not necessarily geometric subgroups in the sense of Damon (1984). This means that the Thom–Mather theory of singularities cannot work properly. However, we have several interesting applications of these equivalence relations, including differential geometry of singular surfaces. We also consider equivalence relations among smooth section germs of vector bundle germs with respect to structure groups. This equivalence relation is a slight generalization of G-equivalence introduced by Tougeron (1972) as a generalization of $\mathcal{K}$-equivalence. However, Tougeron had never mentioned examples of G-equivalence except the original $\mathcal{K}$-equivalence and $\mathcal{R}$-equivalence. We give several interesting applications of this equivalence, including quantum physics (chemistry), determinantal singularities, etc. This equivalence is a geometric subgroup in the sense of Damon, so that the main techniques of the Thom–Mather theory can work properly.

Featured Invited Talks

March 17th (Sun)

Conference Room I

Takashi Suzuki (Osaka Univ.) Methods for Mathematical Oncology ····· (13:00–14:00)

Summary: Mathematical onocology is a fusion of mathematical science and medical science. I show several mathematical methods using data science, mathematical modeling, and numerical methods, then medical outcomes in both fundamental and clinical, that is, maglignant signaling, drug resistence, bone metabolism, and angiogenesis.

Conference Room IV

Hiroakira Ono (JAIST*) Many faces of logical reasonings and their analysis ····· (13:00–14:00)

Summary: Classical logic is a standard framework for formalizing mathematical reasoning. From semantical point of view, it divides mathematical statements into true statements and false ones, in principle. On the other hand, if one will apply classical logic to the analysis of logical reasonings in general, e.g. reasonings in everyday life, one may sometimes feel it uncomfortable and inappropriate. This comes from the fact that the truth in these reasonings will depend often on time, situations, resources and accessible information. Nonclassical logic is a syntactic and semantical study of various logical reasonings, which attracts interest from philosophers to computer scientists nowadays. In my talk, beginning with examples of logical reasonings of different kind I will show how algebraic methods are effectively applied and lead us to a unified understanding of these reasonings.

March 19th (Tue)

Conference Room I

Guest Talk from the Japan Society for Industrial and Applied Mathematics

Takahito Tanabe (NTT DATA Mathematical Systems Inc.) Mathematical Science for Business ····· (13:00–14:00)

Summary: Now that mathematical science is all the rage, and growing rapidly to be an everyday tool to support human prediction, forecast, and decision making in many business fields. Mathematically, we usually solve classical, well-known, and even trivial problems using computers. But interestingly enough, when we pursuit speed, precision or stability, that are usually required in the business context, we cannot commit anything without exploiting special technical tips, algorithms or theory. These are the great achievements our forerunners have left behind in the mathematical community. In this talk, we introduce the achievements that help us greatly on the implementation of mathematical algorithms.

Conference Room IV

Aoi Honda (Kyushu Inst. of Tech.) Non-linear integrals with respect to non-additive monotone measures: game theory, big data analysis, machine learning and so on ····· (13:00–14:00)

Summary: Weakening the additivity for classical measures, which is a natural assumption, to monotonicity, we can describe various processes that have uncertainties controlled by complicated interactions. Lebesgue type integral theory cannot be applied to a monotone measure because of its non-additivity, so several types of integrals including our inclusion-exclusion integral have been proposed and used in many applied studies because they have some preferable and useful properties. Moreover, they allow interpretation by the measure. In this talk, I introduce definitions of nonlinear integrals and describe various relationships between these integrals and other several concepts in other areas corresponding to non-linear integral. In the latter half, I show a method of data analysis applied a non-linear integral using general statistical tools, and results of our attempt of applying to machine learning for big data analysis.

Conference Room V

Koya Shimokawa (Saitama Univ.) Topology and polymer science ····· (13:00–14:00)

Summary: Knot theory and 3-dimentional topology theory have been successfully applied to polymer science. In this talk we will discuss application to polymer material design, DNA topology, and topological polymers. We will discuss the structure of polymer materials using decompositions of the 3-dimensional torus. Polycontinuous pattern of block copolymers can be studied and characterized by using networks, branched surfaces and decomposition of the 3-dimensional torus. Enzymatic action of DNA and structure of multicyclic polymers can be analyzed using knot theory and spatial graph theory. We will discuss some of the recent developments.

March 20th (Wed)

Conference Room IV

Kazuhiko Yamaki (Kyoto Univ.) The geometric Bogomolov conjecture and nonarchimedean geometry ····· (13:00–14:00)

Summary: The arithmetic (resp. geometric) Bogomolov conjecture is a problem in Diophantine geometry over a number field (resp. a function field). Let X be a closed subvariety of an abelian variety over a number field (resp. a function field). Then this conjecture asserts that if X has a dense set of points with small canonical height, then it is a torsion (resp. special) subvariety. While the arithmetic Bogomolov conjecture was established by Ullmo and Zhang as a theorem in 1998, the geometric Bogomolov conjecture was widely open at that time.

The proof of the arithmetic version of the conjecture uses a measure theoretic approach on complex analytic spaces associated to an archimedean place of a number field. The key was an equidistribution theorem of small points, which asserts that a dense set of points with small height are equidistributed in the complex space with respect to the so-called canonical measure.

It was natural to wish an analogue of the proof of the arithmetic version to work in the geometric setting. However, since a function field never has an archimedean place, there is no way to use complex analytic spaces in the geometric setting. To make an analogue, therefore, we need counterparts of complex analytic spaces and the canonical measures on the spaces over an archimedean place.

Here, nonarchimedean analytic geometry, which is developed over a nonarchimedean valued field, can provide us with powerful tools. Since a function field has nonarchimedean places, we can enjoy it (even) in the geometric setting. In fact, the usage of analytic spaces in the sense of Berkovich and measures introduced by Chambert–Loir on them has made remarkable contributions to the conjecture.

In this talk, we will begin by recalling what the Bogomolov conjecture is, and then we will review the approach used in the proof of arithmetic version. Finally, we will explain the nonarchimedean counterparts that can be used in the proof of a partial but important result on the geometric Bogomolov conjecture.

Conference Room V

Michio Jimbo (Rikkyo Univ.) Quantum toroidal algebras and integrable systems ····· (13:00–14:00)

Summary: Conformal field theory admits an infinite family of commuting Hamiltonians known as integrals of motion (IM). After q-deformation, quantum toroidal algebras emerge as the symmetry underpinning their integrability. We give a survey about this subject, including the construction of deformed IM and the description of their spectrum, as well as open questions.

Foundation of Mathematics and History of Mathematics

March 17th (Sun) Conference Room VI

9:00–10:55

1 Shigeru Masuda (Res. Workshop of Classical Fluid Dynamics) — The modeling and calculation of capillary action by Poisson ····· 15

Summary: Providing capillary action in the equilibrium, Poisson assures that the rise of the surface of water is due to the abrupt variation of density in the neighborhood of the wall and of the surface. Poisson discusses this problem in 1831, in the rivalry to the paper/book of Laplace 1806–7 and Gauss 1831. We show Poisson's modeling and calcuration.

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

Summary: Legendre's integrals are based on the arcs of ellipsoid and the number theory. He criticizes Euler's integrals. He proposes the function (H) of arc is expressed with H = A'F + B'E + C'Π. (F, E and Π are the three elliptic functions, A',B' and C' are arbitraries.) Legendre says, this theorem (Π is expressed moreover with F and E), is very important in the theory of the elliptic functions. [1, chapter 23, a.107, p.134]. We discuss Legendre's integrals in emphasizing these points.

3 Shigeru Masuda (Res. Workshop of Classical Fluid Dynamics) — The Legendre's applications of elliptic functions and Poisson's usages owing to Legendre ····· 15

Summary: We discuss Legendre's elliptic functions in 1825. Poisson contrives his method of integral beginning with the paper 1802, and up to the last works, he appreciates fully Legendre's integral method. But for it, Poisson confesses, he couldn't have succeeded in these sorts of integrals. Legendre shows the guide for application in geometry and in mechanics. Poisson adopts Legendre's formulae only after five years since the publication of Legendre's functions and tables in 1825–6ish.

4 Michiyo Nakane — One aspect of formation of analytical mechanics found in Hilbert's lectures ····· 15

Summary: Modern textbooks of mechanics develop their arguments based on the so-called Hamilton's principle. It is inferable 19th-century mathematician W. R. Hamilton introduced this formation. But it not true. This paper shows David Hilbert's lectures in 1922–23 unified Hamilton's optical and dynamical theories and based on the variational principles. His assistant Nordheim showed mechanical theory based on Hamilton's principle in 1927 and gave a standard description on this area.

5 Ken Saito * (Osaka Pref. Univ.*/Yokkaichi Univ.) — Diagrams of solid geometry in Euclid's *Elements* ····· 15

Summary: The diagrams of solid geometry (Books XI-XIII) in Euclid's *Elements* are often drawn by orthogonal projection to one of the planes of the figures treated in the proposition. When a straight line necessary in the demonstration is reduced to one point in such drawing, this line is drawn as if it were viewed from a different angle. This happens in the propositions treating octahedron (XIII.14), icosahedron (XIII.16) and dodecahedron (XIII.17). Such mixture of viewpoints in one diagram suggests that there was no standard way of drawing solid figures, and perhaps there was only very vague concept of three dimensional space independent of each solid figures.

6 Tsukane Ogawa (Yokkaichi Univ.) On Seki Takakazu's "bun jutsu" ····· 15

Summary: We can find a word "bun jutsu" in Seki Takakazu's book *Byoudai Meichi* (*Correction of Abnormal Problems*). It seems certainly to be related to the side writing system which is a traditional method to describe a polynomial in East Asia. The meaning of this word, however, wasn't discussed until now. I will introduce a problem including the word "bun jutsu" and consider its meaning and then clarify that Seki broke with tradition modestly.

7 Mitsuo Morimoto (Yokkaichi Univ./Sophia Univ.*) On numbering manuscripts of the *Taisei Sankei* ····· 15

Summary: The *Taisei Sankei*, one of the most important works on Mathematics in Edo period, was compiled during the period (1683–1695–1710). This 20 volumes work was not published, instead, copied carefully. Nowadays we have more than twenty manuscripts of the *Taisei Sankei* conserved at several libraries in Japan. We propose to enumerate them according to H. Komatsu's article published at the *RIMS kôkyûroku* (2007) and to number each of manuscripts by the Komatsu number, which H. Komatsu used to enumerate manuscripts in his article. He enumerate only twenty manuscripts but mentioned several more. We propose here to number these not yet numbered manuscript. For example, manuscripts of the *Taisei Sankei* conserved at Tsu City Library, Mie Prefecture were not mentioned in Komatsu's paper and hence not yet numbered.

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

Taro Mimura (Hiroshima Univ.) Arabic translation technique of Greek mathematical texts in the Abbasid period with a focus on Arabic version of Apollonius' Conics

Summary: In the history of mathematics, Islamic science played an important role in reviving Greek mathematics by translating almost all Greek mathematical texts into Arabic. We must note that the Arabic translation activity was finished in the early Abbasid period, and afterwards, Islamic scholars studied Greek mathematics by examining the Arabic versions of Greek mathematical works without reading the Greek original texts. Thus, revealing the process of composing these Arabic versions in the Abbasid period is obviously important for us when we consider the formation of "studying Greek mathematics" tradition among Islamic scholars; however, until now there are not enough studies on how Abbasid scholars translated Greek mathematical texts into Arabic. To make a start of examining their translation technique, I will choose the case of the Arabic version of Apollonius' Conics. In the period of the seventh Abbasid caliph al-Ma'mūn (786–833), Banū Mūsā brothers, high officials in the court, endeavored to obtain the entire books of the Conics which originally consisted of 8 books. Despite of their enthusiasm, they only got book 1–7, and then they translated 7 books into Arabic. Today, owing to their Arabic translation, we know the contents of book 5–7 whose Greek texts are lost. In this paper, I will compare the Arabic version of some propositions with the Greek original texts, and scrutinize how Banū Mūsā rendered the Greek text into Arabic, and show their aim of compiling the Arabic version.

12:05–12:35 Mathematics History Team Meeting

14:15–17:40

8 Shotaro Tanaka * Answers to the questions at meeting of 2018 Okayama University ···· 15

Summary: (1) $(S-2)=\Sigma_1 d_0(k)(-1)^{k-1}\{1/(3i)^k\}(z-2i)^{k-1}=\Sigma_1 d_0(k)(-1)^{k-1}(3i)^{-k}(-1)^{k-1}(z-2i)^{k-1}$ $=\Sigma_1(-1)^{k-1}(-1,k-1)(3i)^{-k}(-1)^{k-1}(z-2i)^{k-1}=\Sigma_0(-1)^n(-1,n)\{1/(3i)^{n+1}\}(z-2i)^n=(A-f_1)$.
(2) $(S-2)=\Sigma_1 d_0(k)(-1)^{k-1}\{1/(3i)^k\}(z-2i)^{k-1}=\Sigma_1 d_0(k)(-1)^{k-1}\{1/(3i)^k\}(e^{i\theta})^{k-1}=(1/3i)\Sigma_1 d_0(k)\{(-e^{i\theta})/(3i)\}^{k-1}=(1/3i)\{3i/(3i+e^{i\theta})\}=1/(3i+e^{i\theta})=(B-f_1)\ldots$.
(3) $(A-f_1)=(C-f_1)=(S-2)$. See (1).
(4) $(S-2)=\Sigma_1 d_0(k)(-1)^{k-1}\{1/(3i)^k\}(z-2i)^{k-1}=\Sigma_1 d_0(k)(-1)^{k-1}\{1/(3i)^k\}(3e^{i\theta})^{k-1}=(1/3i)\Sigma_1 d_0(k)\{(-3e^{i\theta})/(3i)\}^{k-1}=(1/3i)\Sigma_1 d_0(k)\{(-3e^{i\theta})/(3i)\}^{k-1}=(1/3i)[1/[1-\{(-3e^{i\theta})/(3i)\}^{k-1}]]$ $=(1/3)\{1/(i+e^{i\theta})=(D-f_1)$.

Summary: The solutions presented by Liu Hui in the chapter 9 of "The Nine Chapters on the Mathematical Art" and "The Sea Island Mathematical Manual" used two methods: by area of rectangles and by similarity of triangles. The Yuelu "Shu" also has the same problem as the problem 9 of "Nine Chapters," so they stated in [1] that "If this problem was solved using the Pythagorian theorem, the people in the late Zhou and the Qin era has already knew the general definition of the theorem". We have not agreed with them easily, however, the solution using similarity of triangles we suggested in [2] was invalid.

Summary: In this talk, we will present some formulae to give the area of circles in the ancient chinese books of mathematics.

Summary: In general, there is no proof system which is sound and complete for standard second-order semantics. We found that in strictly monadic second-order logic, which admits only monadic predicate constants and predicate variables, usual second-order proof systems are sound and complete for standard semantics.

Summary: We introduce a formal system of reduction paths for parallel reduction. Our motivation behind this work comes from a quantitative analysis of reduction systems based on the two viewpoints, computational cost and computational orbit (paths). For the first perspective we have shown a quantitative form of the Church–Rosser theorem with respect to parallel reduction. Next, for the second point we will show that there exists a common reduct leading to which we have a unique path of parallel reduction. Following the notion of normal paths, a graphical representation of reduction paths is provided. In order to prove the unique path property, path matrices are defined as block matrices of adjacency matrices for counting reduction orbits.

Summary: Cut elimination is one of the important problems in sequent systems and there are several methods to prove the cut elimination theorem. In 1989, Dunn and Meyer succeeded to prove the cut elimination theorem for LK-like system of classical logic by using metavaluation, which is introduced in relevant logic. In this talk, we consider a proof of the cut elimination theorem of the sequent calculus GS4 for modal logic S4 by Dunn and Meyer's method.

Summary: Let κ be a cardinal number. The category $\mathbf{CAMA}_\kappa$ of κ-additive complete atomic modal algebras is dually equivalent to the category $\mathbf{MRKF}_\kappa$ of κ-downward directed multi-relational Kripke frames, since the category $\mathbf{NFr}_\kappa$ of κ-complete neighborhood frames is dually equivalent to $\mathbf{CAMA}_\kappa$ and is equivalent to $\mathbf{MRKF}_\kappa$. We present another direct proof of this duality for any regular cardinal κ.

Summary: The disjunction and existence properties are regarded as characteristic features of constructivity of intuitionistic logic. These properties are proved to be independent in intermediate predicate logics. Thus, there are intermediate predicate logics having disjunction property but lacking existence property. We present a simple axiom schema with which we can construct an intermediate predicate logic having disjunction property but lacking existence property. Using this result, we can give a slightly simple proof that there are uncountably many predicate extensions of intuitionistic logic.

Summary: A propositional modal logic L is said to have the Craig interpolation property iff for any formulas φ, ψ, if $L \vdash \varphi \to \psi$, then there exists a formula θ containing only propositional variables that occur in both φ and ψ such that $\varphi \to \theta$ and $\theta \to \psi$ are provable in L. Two stronger versions of interpolation property are known, namely, the Lyndon interpolation property (LIP) and the uniform interpolation property (UIP). We introduced the notion of the uniform Lyndon interpolation property (ULIP) which is a strengthening of both UIP and LIP. We proved several propositional modal logics including **K**, **KT**, **KB**, **GL** and **Grz** enjoy ULIP.

Summary: In 1976, de Jongh and Sambin independently proved the fixed point theorem for the provability logic GL. In particular, Sambin's proof gives an effective procedure for constructing fixed points in GL which is known as Sambin's algorithm. In 2001, Sacchetti introduced the modal logics $\mathsf{wGL}_n = \mathsf{K} + (\Box(\Box^n p \to p) \to \Box p)$ $(n > 1)$ which are weaker than GL, and proved that the fixed point theorem also holds for these logics. However, his proof gives no effective procedure for constructing fixed points in these logics, and he asked the question of the existence of such a procedure. We solved Sacchetti's problem affirmatively, that is, we found an effective procedure for constructing fixed points in Sacchetti's logics.

Summary: Sacchetti introduced the modal logics wGL_n which are fragments of the Gödel–Löb logic GL. Sacchetti's logics have remarkably similar properties to GL, for example, the Craig interpolation property, fixed-point property, having arithmetical interpretations, and so on. Recently Shamkanov proved the Lyndon interpolation property for GL using the circular proof system. In this talk, we apply Shamkanov's argument to the case of wGL_n, and prove the Lyndon interpolation property for these logics.

Summary: Quantum logic has been studied with orthomodular lattices. The semantics required for quantum logic can also be provided by possible worlds semantics (OM-models), whose nature is almost equivalent to the notion of orthomodular lattices. However, OM-models are still under development because some important notions of quantum physics are not included. Thus, in this presentation, an evolutionary form of OM-models is introduced and how it is used will be explained.

Summary: The orthomodular lattice of subspaces of $\mathbb{R}^3$ has two intermediate layers, one is the layer of atoms and the other is the layer of coatoms. Some tautology which is not valid in quantum logic has a counter examples in the class of orthomodular lattices with two intermediate layers. We discuss some properties of orthomodular lattices with two intermediate layers.

March 18th (Mon) Conference Room VI

9:00–11:50

21 Saburou Saitoh * (Gunma Univ.*/Inst. of Reproducing Kernels) We can divide the numbers and analytic functions by zero with a natural sense 15

Summary: We will give a simple survey for an essence of our division by zero.
We would like to answer for the old and general question:
Can we divide the numbers by zero?
For this question, we would like to give a simple and definite answer as in the talk title. We, of course, have to give a simple meaning of division.

22 Keitaroh Uchida Hyper exponential function 15

Summary: I define new special functions called Hyper exponential functions with the symbol exph. The main feature of n-order Hyper exponential functions is that n-order derivatives of the functions are the product of any function and the functions. As one of applications, it will be shown that the second-order Hyper exponential functions can be used to describe the solutions of linear homogeneous differential equations of the second order with variable coefficients. Several graphs of the Hyper exponential functions of second-order are shown. It will be shown how to generate the Hyper exponential functions of n-order. Computers are used to generate the Hyper exponential functions. The list of the differential equations that describe the solutions by using the Hyper exponential functions will be given. The Hyper exponential functions are used to represent solutions for the wave equations and for nonlinear differential equations.

23 Toshimichi Usuba (Waseda Univ.) GCH at strongly compact cardinals 15

Summary: We show that if κ is strongly compact then there is a forcing extension in which κ remains strongly compact and GCH fails at κ.

24 Hiroshi Sakai (Kobe Univ.) Higher stationary reflection and cardinal arithmetic 10

Summary: The reflection of stationary sets consisting of countable sets is known to have interesting consequences on the cardinal arithmetic: It implies that the continuum is less than or equal to the second uncountable cardinal and that the Singular Cardinal Hypothesis holds. In this talk, we will discuss consequences on the cardinal arithmetics of the reflection of stationary sets consisting of uncountable sets.

25 Teruyuki Yorioka (Shizuoka Univ.) Maximal saturated linear orders in $(\omega^\omega, <^*)$ with properties of the real line 15

Summary: Using Laver's technique, Kibedi proved that it is consistent that there exists a maximal saturated linear order in $(\omega^\omega, <^*)$. Moreover, he extended Laver's techinique and proved that it is consistent that there exists a maximal saturated linear order in $(\omega^\omega, <^*)$ and Martin's Axiom holds. Proper Forcing Axiom implies that there are no maximal saturated linear orders in $(\omega^\omega, <^*)$, however, by use of Kibedi's idea, it can be proved that it is consistent that there exists a maximal saturated linear order in $(\omega^\omega, <^*)$ Martin's Axiom holds, and any two $\aleph_1$-dense sets of reals are order-isomorphic.

26 Masanori Itai (Tokai Univ.) On finite approximation 15

Summary: We show that sets of finitely approximated subsets of the reals form sigma-algebras.

27 Hirotaka Kikyo (Kobe Univ.) On Hrushovski's "pseudoplanes" with rational coefficients 15

Summary: Hrushovski constructed pseudoplanes to refute one of Lachlan's conjectures. His pseudoplanes depend on a real parameter. His construction is valid for any real parameters between 0 and 1. But the structure corresponding to a parameter at most 1/2 is not a seudoplane. In the cases that the parameter is a rational number, his "pseudoplane" has a model complete theory and the automorphism group of the "pseudoplane" is a simple group.

28 Misato Nakabayashi (Tohoku Univ.)
Kazuyuki Tanaka (Tohoku Univ.)
Wenjuan Li (Nanyang Tech. Univ.)
On one-variable modal μ-calculus 15

Summary: Modal μ-calculus, introduced by Kozen, is an extension of modal propositional logic by adding a greatest fixpoint operator μ and a least fixpoint operators ν. In this talk, first, we show the relationship between one-variable L_μ-formulas and weak alternating tree automata. Next, we introduce a transfinite extension of parity games.

29 Toshio Suzuki (Tokyo Metro. Univ.) Communication interruption between a game tree and its leaves 15

Summary: We introduce a variant of an AND-OR tree in which leaves are connected to internal nodes via communication channels. These communication channels possibly have high probability of interruption. We give a sufficient condition for interruption probability setting to have the following property: There is no optimal algorithm that is depth-first search (provided that it obeys a certain communication protocol). We give a concrete example of such an interruption setting by means of Riemann zeta functions.

30 Kenshi Miyabe (Meiji Univ.) Coherence of reducibilities with randomness notions 15

Summary: For the pair (r, R) of a reducibility and a randomness notion, we consider the following property: if A is r-reducible to B and A is R-random, then B is R-random. In this case we say these are coherent. Some pairs are coherent but others are not. In particular, Schnorr reducibility is not coherent with computable randomness. Dm-reducibility and tm-reducibility are coherent with n-randomness.

31 Kohtaro Tadaki (Chubu Univ.) A refinement of quantum information theory by algorithmic randomness I 15

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

11:50–12:20 Research Section Assembly

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

Koji Nakazawa (Nagoya Univ.) Proving program correctness: Introduction to separation logic

Summary: Hoare logic is a proof system to deduce some correctness of programs. The correctness of programs is represented by Hoare triples $\{A\}P\{B\}$, which mean the assertions A and B hold respectively before and after execution of the program P.
Separation logic is an extension of the Hoare logic to verify programs operating heap memories. In order to represent quantitative properties of allocated memory blocks, the assertion language is extended by separating conjunctions $A * B$, which corresponds to multiplicative conjunctions in the linear logic.
In this talk, we give a brief introduction of the Hoare logic and the separation logic, and introduce our recent results on the separation logic, in particular, on the logical systems for assertions in the separation logic with inductively defined predicates.

Algebra

March 17th (Sun) Conference Room IV

9:15–11:45

Summary: In arXiv:1002.5047, Feigin and Tipunin introduced ADE type generalization of triplet W-algebra by using geometric method. We checked that this VOA has other expected realizations: as intersection of kernels of the narrow screening operators and as some kind of module extension of the corresponding principal W-algebra. Moreover, we determined the strong generators and proved that the extended part of them are nilpotent in the C_2-algebra.

Summary: A construction of APN functions using the bent function $B(x, y) = xy$ is proposed by C. Carlet in 2011. At this time, two families of APN functions using this construction are known, that is, the family of C. Carlet (2011) and the family of Y. Zhou and A. Pott (2013). We propose another family of APN functions with this construction, which are not CCZ equivalent to the former two families on $\mathbb{F}_{2^8}$. We also propose a family of presemifields and determined the middle, left and right nuclei of the associated semifields.

Summary: A new proof of the Aztec diamond theorem is given. The proof is based on a difference equation to which any solution induces a generating or partition function for (domino-)tilings of the Aztec diamonds and a product expression for it. In particular a specific solution is shown which proves the Aztec diamond theorem by Stanley on a multivariate generating function with a nice product expression.

Summary: In this talk, the $\mathfrak{q}$-crystal structure of signed unimodal factorizations of reduced words of type B and that of signed unimodal factorizations of flattened words of type D are discussed. The relation between signed unimodal factorizations of reduced (flattened) words of type B (resp. D) and the type B (resp. D) Coxeter–Knuth relation are clarified. The explicit algorithm for odd Kashiwara operators on signed unimodal factorizations of reduced words of type B is given. This algorithm is also applicable on signed unimodal factorizations of flattened words of type D without any alterations.

Summary: We give a provisional construction of the Kac–Moody Lie algebra module structure on the hyperbolic restriction of the intersection cohomology complex of the Coulomb branch of a framed quiver gauge theory, as a refinement of the conjectural geometric Satake correspondence for Kac–Moody algebras proposed in an earlier paper with Braverman and Finkelberg. This construction assumes several geometric properties of the Coulomb branch under the torus action. These properties are checked in affine type A, via the identification of the Coulomb branch with a Cherkis bow variety established in a joint work with Takayama.

Summary: Let A be a symmetric order over a complete discrete valuation ring $\mathcal{O}$ and κ the residue field of $\mathcal{O}$. Heller lattices over A are A-lattices defined as direct summands of the kernel of the projective cover of indecomposable $A \otimes \kappa$-modules as A-modules.
In p-modular representation theory, Kawara showed that Heller lattices over group algebras play important roles. Thus, it is natural to study Heller lattices over an arbitrary symmetric order. In this talk, we study Heller lattices over $\mathcal{O}[x,y]/(x^2,y^2)$. As the main result, we see that the tree classes of stable components containing Heller lattices are A_∞.

Summary: Let Λ be an arbitrary finite dimensional algebra and modΛ be the category of finitely generated Λ-modules. In this talk, we show that wide subcategories of modΛ associated with τ-rigid pairs are semistable. This provides a complement of Ingalls–Thomas-type bijections for finite dimensional algebras.

Summary: In this talk, I deal with the finite-dimensional mesh algebras given by stable translation quivers, which are self-injective. The stable module categories have a structure of triangulated categories coming from syzygies. In order to classify the mesh algebras by stable equivalences, I have determined the Grothendieck groups of the stable module categories as invariants. Combining this result with other invariants, I have proved that there are no non-trivial stable equivalences between such mesh algebras.

Summary: Let (X, L) be a polarized manifold of dimension n. In this talk, we consider the dimension of global sections of adjoint bundle $K_X + mL$. In particular, we study the case where $n = 5$, $m \geq n + 1 = 6$ and $h^0(L) > 0$.

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

Summary: The finite-dimensional representations of quantum affine algebras have been extensively studied for last three decades originally in connection with the investigation of solutions of the quantum Yang–Baxter equation with spectral parameters. However they have intricate structures and many basic questions are still open. For example, there exists a notion of "character", called q-character, but the character formulae for irreducible representations are not known in general.
A quantum affine algebra is specified by its Dynkin type. Recently, non-trivial connections among the representation categories of quantum affine algebras of several different Dynkin types (e.g. $\mathrm{A}^{(1)}_{2n-1}$ and $\mathrm{B}^{(1)}_n$, $\mathrm{D}^{(1)}_{n+1}$ and $\mathrm{C}^{(1)}_n$) have been recognized though there are no known explicit algebraic relations on the level of quantum affine algebras themselves. In this talk, I first explain recent developments on the study of such connections. Next, I talk about our results related to this topic, that is, I present ring isomorphisms between "t-deformed" Grothendieck rings (=quantum Grothendieck rings) associated with the representation categories of quantum affine algebras of type $\mathrm{A}^{(1)}_{2n-1}$ and $\mathrm{B}^{(1)}_n$. These isomorphisms imply several new positivity properties of t-deformed q-characters of irreducible representations of type $\mathrm{B}^{(1)}_n$. Moreover, they specialize at $t = 1$ to the isomorphisms between usual Grothendieck rings which is obtained by Kashiwara, Kim and Oh through other methods. This coincidence gives the affirmative answer to Hernandez's conjecture in 2002 for type $\mathrm{B}^{(1)}_n$, which asserts the existence of algorithm to compute the q-characters of irreducible representations. This talk is based on a joint work with David Hernandez.

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

Laurent Demonet (Nagoya Univ.) Combinatorics of mutations and torsion classes

Summary: We consider the lattice tors$A$ of torsion classes on a finite dimensional algebra. While this lattice is usually infinite, we show that it can still be well understood by studying its Hasse quiver. Moreover, we give some interpretation this Hasse quiver in terms of A-modules that permits to study *algebraic quotients of* tors$A$, that is quotients of the form tors$A \twoheadrightarrow \mathrm{tors}(A/I), \mathcal{T} \mapsto \mathcal{T} \cap \mathrm{mod}(A/I)$ for an ideal I of A.
As the Hasse quiver of tors$A$ contains naturally the exchange graph of support τ-tilting modules (as the subset consisting of functorially finite torsion classes), tors$A$ can be viewed as a way to extend mutations, even though the behavior at non-functorially finite torsion classes changes drastically, as we will see on several examples, coming from some join work with Aaron Chan.

March 18th (Mon) Conference Room IV

9:40–12:00

Summary: We answer the following question posed by Arturo Pianzola: describe all twisted forms of the differential Lie algebra $\mathfrak{sl}_n(\mathbb{C}(X))$. Here $\mathfrak{sl}_n(\mathbb{C}(X))$ is given the entry-wise differentiation.

Summary: It was proved by Masuoka and Zubkov that given an affine algebraic supergroup G and closed sub-supergroup H over an arbitrary field of characteristic $\neq 2$, the faisceau $G\tilde{/}H$ (in the fppf topology) is a superscheme, and is, therefore, the quotient superscheme G/H, which has desirable properties, in fact. We reprove this, by constructing directly the latter superscheme G/H. Our proof describes explicitly the structure sheaf of G/H, and reveals some geometric features of the quotient.

Summary: Let k be an algebraically closed field of characteristic $p > 0$. Let $G = \mathrm{SL}_2$ be the special linear group of degree 2 over k and G_r the r-th Frobenius kernel of G. In 1983, Wong gave some generating sets of the Jacobson radical of the hyperalgebra $\mathcal{U}_r = \mathrm{Dist}(G_r)$ of G_r for $r = 1$. Here we report that this result can be generalized to the case for general r, using primitive idempotents of the hyperalgebra $\mathcal{U}_r$ constructed by the speaker before.

Summary: Let B be a ring with identity, ρ an automorphism of B, D a ρ-derivation, and q a central (ρ, D)-constant element in B. By $B[X;\rho,D]^q$ we denote a q-skew polynomial ring in which the multiplication is given by $\alpha X = X\rho(\alpha) + D(\alpha)$ $(\forall \alpha \in B)$. In this talk, we shall study a weakly separable polynomial f in $B[X;\rho,D]^q$ of the form $f = X^m + X^{m-1}a_{m-1} + \cdots Xa_1 + a_0$ $(m \geq 2,\ a_i \in B\ (0 \leq i \leq m-1))$, and we shall give a necessary and sufficient condition for a weakly separable polynomial f. In addition, we shall show the difference between the separability and the weak separability in $B[X;\rho,D]^q$ under certain conditions.

Summary: For an artin algebra, Brenner showed that how to determine the number of indecomposable direct summands of the middle term of an almost split sequence starting with a simple module. Let K be an algebraically closed field and $A = K\Delta_A/I$ a truncated quiver algebra. For a Hochschild extension algebra of A. We give a simple interpretation of a theorem of Brenner by focusing on the number of nonzero cycles in the Hochschild extension algebra.

15 Masaki Matsuno (Shizuoka Univ.)
Ayako Itaba (Tokyo Univ. of Sci.)
AS-regularity of geometric algebras associated to elliptic curves ····· 15

Summary: It is known that a 3-dimensional quadratic AS-regular algebra is a geometric algebra, however, the converse is not true. In this talk, we give a necessary and sufficient condition that a geometric algebra associated to an elliptic curve E in $\mathbb{P}^2_k$ is a 3-dimensional quadratic AS-regular algebra. Moreover, we show that every 3-dimensional quadratic AS-regular algebra corresponding to an elliptic curve E in $\mathbb{P}^2_k$ is graded Morita equivalent to a 3-dimensional Sklyanin algebra.

16 Kenta Ueyama (Hirosaki Univ.)
On Knörrer periodicity in a noncommutative setting ····· 15

Summary: We focus on the structure of the stable category $\underline{\mathsf{CM}}^{\mathbb{Z}}(S/(f))$ of graded maximal Cohen–Macaulay module over $S/(f)$ where S is a graded (± 1)-skew polynomial algebra in n variables of degree 1, and $f = x_1^2 + \cdots + x_n^2$. If S is commutative, then the structure of $\underline{\mathsf{CM}}^{\mathbb{Z}}(S/(f))$ is well-known by Knörrer's periodicity theorem. It will be explained that if $n \leq 5$, then the structure of $\underline{\mathsf{CM}}^{\mathbb{Z}}(S/(f))$ is determined by the number of irreducible components of the point scheme of S which are isomorphic to $\mathbb{P}^1$.

17 Toshinori Kobayashi (Nagoya Univ.)
Characterizations of the endomorphism ring of the maximal ideal of a Gorenstein local ring ····· 10

Summary: We mainly consider Cohen–Macaulay local rings of dimension one. The most typical example of a finite birational extension of them is the endomorphism ring of the maximal ideal. Such a extension have been used to understand representation-theoretic properties of rings. For example, Bass used it to study indecomposable torsion-free modules. The aim of this talk is to study the endomorphism rings of the maximal ideal of Gorenstein local rings. We will give some characterizations of them, and show the relation between self-duality of the maximal ideal and some other properties (Teter's condition, almost Gorensteiness, etc).

18 S. K. Masuti (Chennai Math. Inst.)
Kazuho Ozeki (Yamaguchi Univ.)
M. E. Rossi (Genova Univ.)
A filtration of the Sally module and the first normal Hilbert coefficient ····· 15

Summary: The Sally module of an ideal is an important tool to interplay between Hilbert coefficients and the properties of the associated graded ring. In this talk we give new insights on the structure of the Sally module. We apply these results characterizing the almost minimal value of the first normal Hilbert coefficient in an analytically unramified Cohen–Macaulay local ring.

13:15–14:15

19 Takayuki Hibi (Osaka Univ.)
Kyouko Kimura (Shizuoka Univ.)
Kazunori Matsuda (Kitami Inst. of Tech.)
Extremal Betti numbers of edge ideals ····· 10

Summary: Let G be a finite simple graph on the vertex set V. Also let $S = K[V]$ be a polynomial ring over a field K whose variables are vertices of G. Then we define the edge ideal $I(G) \subset S$ of G. In the talk, we will show that given integers r and b with $1 \leq b \leq r$, there exists a finite simple connected graph G such that the regularity of $S/I(G)$ is equal to r and the number of extremal Betti numbers of $S/I(G)$ is equal to b.

20 Hidefumi Ohsugi (Kwansei Gakuin Univ.)
Akiyoshi Tsuchiya (Osaka Univ.)
Takayuki Hibi (Osaka Univ.)
Normality and Gorensteinness for Cayley sums of order and stable set polytopes 15

Summary: Normal lattice polytopes turn up in many fields of mathematics. It is known that if the Cayley sum of lattice polytopes is normal, then so is their Minkowski sum. In this talk, the Cayley sum of the order polytope of a finite poset and the stable set polytope of a finite simple graph is discussed. We show that the Cayley sum of an order polytope and the stable set polytope of a perfect graph is normal, and hence so is their Minkowski sum. Moreover it turns out that, for an order polytope and the stable set polytope of a graph, the following conditions are equivalent: (i) the Cayley sum is Gorenstein; (ii) the Minkowski sum is Gorenstein; (iii) the graph is perfect.

21 Kohsuke Shibata (Okayama Univ.)
Kohji Yanagawa (Kansai Univ.)
Relation between the irreducible decomposition of strongly stable ideals and their local cohomology 10

Summary: Let $I \subset S = K[x_1, \ldots, x_n]$ be a strongly stable ideal whose generators have degree at most d. It is known that I admits the *alternative polarization* b-pol$(I) \subset K[x_{i,j} \mid 1 \leq i \leq n, 1 \leq j \leq d]$. This is a very useful tool in the study of strongly stable ideals. We give an easy procedure to construct the irreducible decomposition of b-pol(I) from that of I. Furthermore, we describe the Hilbert series of $H^i_{\mathfrak{m}}(S/I)$ from the irreducible decomposition of I via b-pol(I) and the Eliahou–Kervaire formula.

22 Koji Chinen (Kindai Univ.)
Yuki Imamura (interprism Inc.)
On the Riemann hypothesis for self-dual weight enumerators of genus three 10

Summary: We give an equivalent condition for a self-dual weight enumerator of genus three to satisfy the Riemann hypothesis. We also observe the truth and falsehood of the Riemann hypothesis for a certain family of invariant polynomials.

March 19th (Tue) Conference Room IV

9:20–12:00

23 Fumitsuna Maruyama
Yoshiyasu Yasutomi (Tokyo Nat. Coll. of Tech.)
On a certain bijection from $\mathbb{N}^m$ to $\mathbb{N}$ 10

Summary: We report a bijection from $\mathbb{N}^m$ to $\mathbb{N}$ represented by a polynomial.

24 Shigeru Iitaka (Gakushuin Univ.*)
Hiroto Takahashi (Ikenoue Elementary School)
Super perfect numbers and super twin primes 10

Summary: Let P denote a prime and m an integer. Positive integers a and A are said to be a super perfect number and its partner, if they satisfy $A = \sigma(a) + m, \overline{P}\sigma(A) = aP + P - 2 + m\overline{P}$, where $\overline{P} = P - 1$ and let $\sigma(n)$ denote a sum of divisors of n.
Assume that $P = 3, m = -8$. If a is a prime p , A turns out to be $2q$, q being a prime. Then both $(q, p = 2q + 7)$ are called super twin primes.
Let P denote a prime and m an integer. Positive integers a and A are said to be a super perfect number and its partner.

25 Wataru Takeda (Nagoya Univ.)
Factorial function over number fields and quadratic forms 10

Summary: We study the number of integer solutions (x, y, m) of an equation $f(x, y) = \Pi_K(n)$, where $f(x, y)$ is a quadratic form with integer coefficients and $\Pi_K(n)$ is a generalized factorial function over number fields. We show a necessary and sufficient condition for the existence of infinitely many solutions.

Summary: A Heron triangle is a triangle having the property that the lengths of its sides as well as its area are positive integers. In this talk, we show that the exponential Diophantine equation $c^x + b^y = a^z$ concerning Heron triples a, b, c has only the positive integer solution $(x, y, z) = (1, 1, 2)$ under some conditions. The proof is based on elementary methods and Baker's method.

Summary: Let $Z_N(X)$ be the zeta polynomial of the Nth cyclotomic function field of characteristic p. In this talk, we generalize Goss–Bernoulli polynomials, and characterize irreducible components of $Z_N(X)$ mod p. As an application of our result, for given $f(X) \in \mathbb{F}_p[X]$, we see that there are infinitely many irreducible polynomial N such that $Z_N(X)$ mod p is divided by $f(X)$.

Summary: Height-one duality is the relations among finite multiple zeta values (FMZVs) derived from the hoffman duality and the reversal relation. Kaneko and Ohno proved an analogue of the height-one duality for multiple zeta-star values and conjectured a kind of duality of multiple zeta-star values for arbitrary heights. This conjecture was proved by Li. On the other hand, (for FMZVs,) Kaneko conjectured a generalization of the height-one duality for arbitrary heights. Moreover, based on the conjecture due to Kaneko and Zagier, it is expected that Kaneko's conjecture holds also for symmetric multiple zeta values (SMZVs). In this talk, we prove the conjectures for both FMZVs and SMZVs.

Summary: Matsumoto proved that Euler–Zagier double zeta function satisfies a functional equation including confluent hypergeometric functions. After that, Okamoto and Onozuka obtained same type functional equation for Mordell–Tornheim multiple zeta functions, which generalized Matsumoto's result. On the other hand, we introduced a combinatorial object called 2-colored rooted tree and a multiple zeta function associated with it, which is a common generalization of Euler–Zagier and Mordell–Tornheim multiple zeta functions. In this talk, we will explain that multiple zeta functions associated with certain 2-colored rooted trees satisfy a same type functional equations. This result gives a generalization of Okamoto–Onozuka's result.

Summary: Cusp forms for the full modular group can be written as linear combination of the Eisenstein series and the double Eisenstein series introduced by Gangl, Kaneko and Zagier. We give an explicit formula for decomposing a Hecke eigenform into double Eisenstein series.

Summary: In this talk, we compute special values of L-functions of modular forms which are products of the Jacobi theta series or the Borwein theta series. We express L-values at $s = 1$ of weight 3 theta products in terms of special values of generalized hypergeometric functions.

Summary: We derive an analogue to the Poisson summation formula, in terms of the Laplace transform. This allows us to deduce the functional equation, approximate functional equation, and a fast and absolutely convergent algorithm for the Riemann zeta function, Dirichlet L-functions and the Lerch zeta function, within a unified framework.

33 Ade Irma Suriajaya (RIKEN) Mean-values associated with Schemmel's function 15
Jörn Steuding (Univ. of Würzburg)

Summary: V. Schemmel in 1869 introduced an arithmetic function $\varphi_m(n)$ which generalizes the Euler's totient function by introducing a positive integer coefficient m in the prime factor of the product representation of Euler's totient function. The Euler's totient function is a special case when $m = 1$. We extended this definition of $\varphi_m(n)$ to all integers m and considered its mean-values with respect to both m and n.

14:15–15:05

34 Hideaki Morita (Muroran Inst. of Tech.) The Euler expression for the zeta function associated with a family of finite sets 10

Summary: We consider zeta functions defined for a family of finite sets. This class of zeta functions includes the Ihara zeta function or other graph zeta functions. In this talk, the conditions which rewrite the exponential expression to the Euler product expression for those zetas.

35 Hideaki Morita (Muroran Inst. of Tech.) The Hashimoto expression for the zeta function associated with a family of finite sets 10

Summary: We consider zeta functions defined for a family of finite sets. This class of zeta functions includes the Ihara zeta function or other graph zeta functions. In this talk, the conditions which rewrite the Euler product expression to the Hashimoto expression for those zetas.

36 Hideaki Morita (Muroran Inst. of Tech.)[b] The three expresisons for the combinatorial zeta functions. 10
Iwao Sato (Oyama Nat. Coll. of Tech.)

Summary: The combinatorial zeta function is the zeta function defined for a combinatorial structure, such as a finite graph, discrete dynamical system, a finite group and so on, which has the three wxpressions. We will see that the circulatory of the weight deduces the existence of the three expressions.

37 Ayaka Ishikawa (Yokohama Nat. Univ.) Ihara expression of the zeta function of a finite digraph 10
Hideaki Morita (Muroran Inst. of Tech.)
Iwao Sato (Oyama Nat. Coll. of Tech.)

Summary: The Ihara expression is an expression of graph zeta functions. Sato obtained the Ihara expression of the second weighted zeta function, which relates to quantum walks via Konno–Sato's theorem. In this talk, we define the "generalized Sato zeta function" which extends the second weighted zeta function, and we derive its Ihara expression.

15:15–15:30 Presentation Ceremony for the 2019 MSJ Algebra Prize

15:35–16:35 Award Lecture for the 2019 MSJ Algebra Prize

Shunsuke Takagi (Univ. of Tokyo) Singularities of algebraic varieties and characteristic p methods

Summary: F-singularities are a generic term used to refer to singularities in positive characteristic defined via the Frobenius map. They are conjectured to correspond, via reduction modulo $p > 0$, to singularities in complex birational geometry. I will survey recent developments around this conjecture. In addition, I will explain an application of F-singularities to birational geometry in positive characteristic. I will also mention some vanishing results on local cohomology to emphasize the different behavior of singularities in characteristic zero and in positive characteristic.

16:45–17:45 Award Lecture for the 2019 MSJ Algebra Prize

Shinichi Kobayashi (Kyushu Univ.) Iwasawa theory —Past and present—

March 20th (Wed) Conference Room IV

9:10–12:00

38 Motoo Ohaga (Hokkaido Univ.)
Keiji Nakatsugawa (Hokkaido Univ.)
Toshiyuki Fujii (Asahikawa Med. Univ.)
Toyoki Matsuyama (Nara Univ. of Edu.)
Satoshi Tanda (Hokkaido Univ.)
Deductive reinterpretation of the Nakano–Nishijima–Gell-mann formula 10

Summary: The Nakano–Nishijima–Gell-Mann formula (NNG fomula) is well known as an equation that relates certain quantum numbers of elementary particles to their charge number. This theory is constructed by using the group theory with real number, and introduces the quantum numbers I_z (isospin), S (strangeness), etc. phenomenologically. But according to a previous suggestion, in the finite world the relation between quantum numbers and charge numbers is represented by a discrete gauge transformation in a finite field. We rewrite this representation instead of using the NNG formula, and predict relation of quantum numbers of Hadron including Pentaquark. Furthermore, we get discreteness of charge as characteristic of finite field.

39 Akinari Hoshi (Niigata Univ.)
Ming-chang Kang (Nat. Taiwan Univ.)
Aiichi Yamasaki (Kyoto Univ.)
Noether's problem for $N \rtimes A_6$ 10

Summary: Let A_6 be the alternating group of degree 6. We give a negative answer to Noether's problem for $N \rtimes A_6$ over $\mathbb{C}$ where N is some abelian group.

40 Akinari Hoshi (Niigata Univ.)
Aiichi Yamasaki (Kyoto Univ.)
Rationality problem for norm one tori 10

Summary: We give a stably and retract rational classification of norm one tori of dimension $p-1$ where p is a prime number and of dimension up to ten with some minor exceptions.

41 Sumito Hasegawa (Niigata Univ.)
Akinari Hoshi (Niigata Univ.)
Aiichi Yamasaki (Kyoto Univ.)
Rationality problem for norm one tori, II 10

Summary: We give a stably and retract rational classification of norm one tori of dimension $n-1$ for $n = 2^e$ ($e \geq 1$) is a power of 2 and $n = 12, 14, 15$. Retract non-rationality of norm one tori for primitive $G \leq S_{2p}$ where p is a prime number and for the five Mathieu groups $M_n \leq S_n$ ($n = 11, 12, 22, 23, 24$) is also given.

42 Takanori Nagamine (Niigata Univ.)
A note on retracts of polynomial rings in three variables 15

Summary: In Costa's paper published in 1977, he asks us whether every retract of $k^{[n]}$ is also the polynomial ring or not, where k is a field. In this talk, we give an affirmative answer in the case where k is a field of characteristic zero and $n = 3$.

43 Takeshi Usa (Univ. of Hyogo)
Betti constancy on the syzygies and the differentials of Koszul graph maps 15

Summary: We improve our previous results on homological shells. Let X be an arithmetically D_2 closed subscheme of $P^N(C)$, and W a homological shell of X. We construct the universal family of homological shells of X which includes W. We describe the Zariski tangent space at the point $[W]$, the smoothness condition at $[W]$, the differential of the (universal) Koszul graph map at $[W]$ by using cohomological pairing.

Summary: Let $\mathbf{D}$ be a triangulated category of coherent sheaves on a smooth projective variety. Then the category $\mathbf{D}^{\Delta^1}$ of morphisms in $\mathbf{D}$ is also triangulated. Hence one can assign the space $\mathrm{Stab}\mathbf{D}^{\Delta^1}$ of stability conditions on $\mathbf{D}^{\Delta^1}$ though the non-emptiness of it is not obvious. The aim of this talk is a comparison of the spaces of stability conditions on $\mathbf{D}^{\Delta^1}$ and that on $\mathbf{D}$ after the proof of non-emptiness of $\mathrm{Stab}\mathbf{D}^{\Delta^1}$. In particular we discuss the case that $\mathbf{D}$ is the derived category of a smooth projective curve.

Summary: We consider the Hilbert scheme H which parameterizes all closed subschemes of $\mathbb{P}^n$ with fixed Hilbert polynomial P. If we fix a monomial order $\prec$ on the polynomial ring S in $n+1$ variables, each homogeneous ideal in S has a unique reduced Gröbner basis with respect to $\prec$. Using this fact we can decompose the Hilbert scheme H into the locally closed subschemes of H called Gröbner schemes. On the other hand, Bialynicki–Birula shows that any smooth projective scheme with a 1-dimensional torus action has a cell decomposition called Bialynicki–Birula decomposition. In this talk, I would like to explain Gröbner schemes and compare two decompositions of the Hilbert scheme H.

Summary: We study the finite F-representation type (abbr. FFRT) property of a two-dimensional normal graded ring R in characteristic p>0, using notions from the theory of algebraic stacks. Given a graded ring R, we consider an orbifold curve, which is a root stack over the smooth curve C=Proj R, such that R is the section ring associated with a line bundle L on C. The FFRT property of R is then rephrased with respect to the Frobenius push-forwards on the orbifold curve. As a result, we see that if the singularity of R is not log terminal, then R has FFRT only in exceptional cases where the characteristic p divides a weight of the orbifold curve.

Summary: In this talk, we introduce some recent study of the embedded topology of smooth quartics and its bitangent lines via two-graphs and apply it to construct interesting examples for Zariski m-ples.

Summary: A curve is said to be *superspecial* if its Jacobian is isomorphic to a product of supersingular elliptic curves. In recent years, the speakers succeeded in enumerating superspecial curves of genus four in small characteristic. This study is the first attempt to obtain an analogous result for genus *five*. We propose a feasible algorithm to enumerate superspecial curves in the case of trigonal ones of genus five over an arbitrary finite field. We implemented the algorithm over a computer algebra system Magma, and succeeded in enumerating superspecial trigonal curves of genus five over small finite fields.

14:15–15:40

49 Makoto Sakurai — Chiral homology and cobordism hypothesis of conformal blocks ····· 15

Summary: I have used the result of Beilinson–Drinfeld some time ago. However, its result was restricted to the chapter 3 of local theory. I would like to continue my trial in the chapter 4 of the global theory and conformal blocks. It is by use of chiral homology of twisted D-modules and the cobordism conjecture of Jacob Lurie. I would like to start from reviewing my computation results of OPEs. Then I will consider the Matsushima obstruction and spin structure by Stiefel–Whitney class and signature. Then I would like to consider the hypothetical L_∞-algebra structure of string field theory. Noncommutative deformation of Poisson bracket and noncommutative geometry of chiral algebra are the key to define such structures.

50 Masaaki Murakami (Kagoshima Univ.) — On a certain type of algebraic surfaces with $c_1^2 = 9$ and $\chi = 5$ ····· 15

Summary: I shall explain my recent study on surfaces with $c^2 = 9$ and $\chi = 5$ whose canonical classes are divisible by 3 in the integral cohomology group, where c_1^2 and χ denote the first Chern number of an algebraic surface and the Euler characteristic of the structure sheaf, respectively. The main results are a structure theorem for such surfaces, the unirationality of the moduli space, and a description of the behavior of the canonical map. As a byproduct, we can rule out a certain case mentioned in a paper by Ciliberto–Francia–Mendes Lopes.

51 Akira Mori (Kobe Univ.) — Nef cone of a generalized Kummer 4-fold ····· 10

Summary: In this talk, we calculate the boundary of movable cones and nef cones of the generalized Kummer 4-fold attached to an abelian surface with Picard number 1.

52 Atsushi Kanazawa (Kyoto Univ.) — Degenerations and mirror symmetry of Calabi–Yau manifolds ····· 15

Summary: We discuss the Doran–Harder–Thompson conjecture, which claims that when a Calabi–Yau manifold X degenerates to a union of two quasi-Fano manifolds (Tyurin degeneration), a mirror Calabi–Yau manifold of X can be constructed by gluing the two mirror Landau–Ginzburg models of the quasi-Fano manifolds. We provide a sketch of a proof in the case of elliptic curves and abelian surfaces.

53 Tomohiro Iwami (Kyushu Inst. of Tech.)* — Characterization of Mukai–Umemura 3-folds in terms of an extended extremal curve neighborhood ····· 15

Summary: For a 3-dimensional extremal curve neighborhood (or, extremal curve germ) (X, C) with an extremal curve C which is not necessary irreducible or reducible, we formulate numerical invariants associated to $\mathrm{gr}^{n,i}(\mathscr{O}, J)$ (S. Mori, 1988) along properties about the normal bundle for such a (X, C) (A. G. Kuznetsov, Y. G. Prokhorov, C. A. Shramov, 2018). In such a process, we use our previous results (the Math. Soc. Japan meeting (Sep. 2018)) on which a line bundle induced from $\omega_X^\vee$ on C of type (IIA) as a l-split direct summand is given from the moduli space of certain semi-stable sheaves by a coherent system and Trautmann's moduli (Le Potier, 1993). As a result, we give a kind of LG-deformation (S. Mori, 1988) for Mukai–Umemura 3-folds,and give an inequality between the associated Chern classes c_i $(i \in [1, 3])$ of Miyaoka–Yau type for such a (X, C).

Geometry

March 17th (Sun) Conference Room V

9:40–11:40

1 Honoka Kobayashi (Tokyo Univ. of Sci.)
Naoyuki Koike (Tokyo Univ. of Sci.)
Pseudo-hyperbolic Gauss maps of Lorentzian surfaces in anti-de Sitter space ····· 15

Summary: We investigated oriented Lorentzian surfaces of constant mean and Gaussian curvatures and non-diagonalizable shape operator in the 3-dimensional anti-de Sitter space. It is known that such Lorentzian surfaces are either a B-scroll or a complex circle. We determined the type numbers of the pseudo-hyperbolic Gauss maps of a B-scroll and a complex circle. Also, we investigated the behavior of the type numbers of the pseudo-hyperbolic Gauss maps along their parallel families.

2 Naoto Satoh (Hokkaido Univ.)
Local existence of statistical diffeomorphisms ····· 10

Summary: Statistical manifolds are manifolds endowed with a torsion-free affine connection and a Riemannian metric. A statistical manifold is said to be a Hessian manifold if its affine connection is flat. A diffeomorphism between statistical manifolds is said to be statistical if it preserves statistical structures. Our purpose is to find conditions that guarantee an extension of a given linear isomorphism between given tangent spaces to a local statistical diffeomorphism. We explain that a statistical structure is locally characterized by its Riemannian curvature tensor and difference tensor. In addition, we also show that a Hessian structure is locally determined by its Hessian curvature tensor and difference tensor.

3 Shintaro Akamine (Nagoya Univ.)
Masaaki Umehara (Tokyo Tech)
Kotaro Yamada (Tokyo Tech)
Improvement of the Bernstein-type theorem for maximal surfaces in spacetime using fluid mechanical duality ····· 15

Summary: Calabi's Bernstein-type theorem asserts that a zero mean curvature entire graph in Lorentz–Minkowski space which admits only space-like points is a space-like plane. Using the fluid mechanical duality between minimal surfaces in Euclidean 3-space and maximal surfaces in Lorentz–Minkowski space, we give an improvement of this Bernstein-type theorem. More precisely, we show that a zero mean curvature entire graph which does not admit time-like points (namely, the graph consists of only space-like and light-like points) is a plane.

4 Atsufumi Honda (Yokohama Nat. Univ.)
Kentaro Saji (Kobe Univ.)
Keisuke Teramoto (Kobe Univ.)
Mixed type surfaces with bounded Gaussian curvature in three-dimensional Lorentzian manifolds ····· 15

Summary: A mixed type surface is a connected regular surface in a Lorentzian 3-manifold with non-empty spacelike and timelike point sets. The induced metric of a mixed type surface is a signature-changing metric, and their lightlike points may be regarded as singular points of such metrics. In this talk, we exhibit several results on the behavior of Gaussian curvature at a non-degenerate lightlike point of a mixed type surface. To characterize the boundedness of Gaussian curvature at a non-degenerate lightlike points, we introduce several fundamental invariants along non-degenerate lightlike points, such as the lightlike singular curvature and the lightlike normal curvature. Moreover, using the results by Pelletier and Steller, we obtain the Gauss–Bonnet type formula for mixed type surfaces with bounded Gaussian curvature.

5 Tatsumasa Ura (Fuka Secondary School)
Shoichi Fujimori (Okayama Univ.)
Constant negative Gaussian curvature tori and their singularities ····· 15

Summary: We construct constant negative Gaussian curvature tori with one family of planar curvature lines in Euclidean 3-space. The singularities of these tori are studied.

6 Vasile Sorin Sabau (Tokai Univ.)
Kazuyoshi Kiyohara (Okayama Univ.)
Kazuhiro Shibuya (Hiroshima Univ.)
The geometry of a positively curved Zoll surface of revolution ····· 15

Summary: In this talk, we present the geometry of the manifolds of geodesics of a Zoll surface of positive Gauss curvature, show how these metrics induce Finsler metrics of constant flag curvature and give some explicit constructions.

7 Nobuhiro Innami (Niigata Univ.)
The asymptotic behavior of geodesic circles in a surface ····· 15

Summary: Let M be an orientable finitely connected and geodesically convex Finsler 2-manifold with genus $g \geq 1$. We assume that some closed geodesics are reversible. However, the 2-manifold M does not need to be complete and without boundary. We prove that for any number $\varepsilon > 0$ and for any points $p, q \in M$ there exists a number $R > 0$ such that any geodesic circle with center p and radius t meets the ε-ball with center q if $t > R$.

14:20–16:25

8 Masayuki Igarashi (Tokyo Univ. of Sci.)*
On Hermite–Liouville structures on the elliptically deformed Hopf surfaces ····· 10

Summary: In this talk, we discuss the Elliptically deformed Hopf surfaces with hermitian metrics, and construct Hermite–Liouville structures on them and find the first integrals on their cotangent bundles of their geodesic flows. Also, we see the complete integrability of their geodesic flows by virtue of the structures and the first integrals. The argument in this talk is a continuation of the previous talk given by the speaker at the MSJ Spring Meeting 2018.

9 Daisuke Tarama (Ritsumeikan Univ.)
Stability analysis for the Mishchenko–Fomenko geodesic flow on a real semi-simple Lie group ····· 15

Summary: This talk is based on a joint work with Tudor Ratiu (Shanghai Jiao Tong University). The stability of the isolated equilibria is considered for Euler equation of the Mishchenko–Fomenko geodesic flow on an arbitrary real semi-simple Lie group, by using the results of Bolsinov and Oshemkov for bi-Hamiltonian systems. It is shown that the type of an isolated equilibrium on a generic orbit can be characterized by the respective numbers of the real, purely imaginary, and complex roots.

10 Kentaro Hara (Tokyo Univ. of Sci.)
Akifumi Sako (Tokyo Univ. of Sci.)
Hyun Seok Yang (Sogang Univ.)
Hermitian–Einstein metrics from instantons ····· 10

Summary: We show that Hermitian–Einstein metrics can be constructed locally by a map of (anti-) self-dual bifurcations on Euclidean R^4 to symmetric two-tensors introduced in "Gravitational instantons from gauge theory," H. S. Yang and M. Salizzoni, Phys. Rev. Lett. (2006) 201602, [hep-th/0512215]. This correspondence applies not only to a commutative space, but also to a non-commutative space. We choose U(1) instantons on a noncommutative C^2 as a self-dual form, from which we derive a family of Hermitian–Einstein metrics. We also discuss the condition when the metric becomes Kaehler.

11 Hokuto Konno (Univ. of Tokyo)
Masaki Taniguchi (Univ. of Tokyo)
Positive scalar curvature and 10/8-type inequalities on 4-manifolds with periodic ends ····· 15

Summary: We show 10/8-type inequalities for some end-periodic 4-manifolds which have positive scalar curvature metrics on the ends. As an application, we construct a new family of closed 4-manifolds which do not admit positive scalar curvature metrics.

12 Shinichiroh Matsuo (Nagoya Univ.)♭
Asymptotic diameter growth of the instanton moduli spaces of the four-sphere ····· 15

Summary: We have studied asymptotic diameter growth of the instanton moduli spaces of the four-sphere, which partly solved Donaldson's conjecture.

13 Isami Koga (Meiji Univ.)
Yasuyuki Nagatomo (Meiji Univ.)
Classification of equivariant harmonic maps from complex projective line into complex Grassmannian of two-planes 15

Summary: First of all, we introduce the relation between vector bundles over a manifold and maps from the manifold into Grassmannian manifolds. And then we classify harmonic maps from complex projective line into the complex Grassmannian manifolds of two-planes which have certain conditions.

14 Isami Koga (Meiji Univ.)
Masaro Takahashi (Kurume Nat. Coll. of Tech.)
A construction of equivariant holomorphic embedding from complex projective space into the complex Grassmannian 10

Summary: In this talk, we construct a one-parameter family of equivariant holomorphic embedding from complex projective space into the complex Grassmannian.

15 Naoyuki Koike (Tokyo Univ. of Sci.)
Regularized mean curvature flow in a Hilbert space and its application to the gauge theory 15

Summary: We considered the regularized mean curvature flow starting from an invariant hypersurface in a Hilbert space equipped with an isometric and almost free action of a Hilbert Lie group whose orbits are regularized minimal. We proved that, if the invariant hypersurface satisfies a certain kind of horizontally convexity condition and its image by the orbit map of the Hilbert Lie group action is included by the geodesic ball of some radius, then it collapses to an orbit of the Hilbert Lie group action along the regularized mean curvature flow. As an application of this result to the gauge theory, we derived a result for the behavoiur of the holonomies (along a fixed loop) of connections belonging to some based gauge-invariant hypersurface in the space of connections on the principal bundle having a compact semi-simple Lie group as the structure group along a natural flow starting from the hypersurface.

16:40–17:40 Talk Invited by Geometry Section

Yasushi Homma (Waseda Univ.) Toward spin 3/2 geometry

Summary: Spin geometry deals with the Dirac operator and spinors on spin manifolds. One of the famous theorems is that there exists no non-trivial harmonic spinor on a positive scalar curvature manifold because of Lichnerowicz's formula. What happen for the spin 3/2 case? As stated in the physics literature, the Rarita–Schwinger operator on spin 3/2 fields is an analog of the Dirac operator. If a spin 3/2 field is in the kernel of the Rarita–Schwinger operator, we call it a Rarita–Schwinger field. In contrast to spin 1/2 case, positive scalar curvature is not the condition to rule out the existence of RS fields. In fact, we can find examples of compact Einstein manifolds with/without RS fields, where the key is to use a variety of Weitzenböck formulas. For instance, we have a complete classification of quaternionic-Kähler manifolds and symmetric spaces admitting RS fields. In this talk, I will present recent results by a joint research with U. Semmelmann for RS fields and related Weitzenböck formulas.

March 18th (Mon) Conference Room V

9:50–11:40

16 Homare Tadano (Tokyo Univ. of Sci.)
A new compactness theorem via m-Bakry–Émery Ricci curvature with positive m 15

Summary: We establish a new compactness theorem for complete Riemannian manifolds via m-Bakry–Émery Ricci curvature with positive m. Our result generalizes the Myers-type theorem via m-Bakry–Émery Ricci curvature by M. Limoncu (2010) and may be compared with Ambrose- and Cheeger–Gromov–Taylor-type theorems via m-Bakry–Émery Ricci curvature by the author (2016).

17 Homare Tadano (Tokyo Univ. of Sci.) Some compactness theorems for transverse Ricci solitons on complete Sasaki manifolds 15

Summary: We establish some new compactness theorems for transverse Ricci solitons on complete Sasaki manifolds. Our results are natural generalizations of the Myers-type theorem by M. Fernández-López and E. García-Río (2008) and M. Limoncu (2010), and the Cheeger–Gromov–Taylor-type theorem by the author (2016).

18 Daisuke Kazukawa (Tohoku Univ.) Concentration of l_p-product spaces 15

Summary: As metrics on the set of all metric measure spaces, there are the box distance and the observable distance introduced by Gromov. The topology induced by the observable distance is called the concentration topology and is weaker than one induced by the box distance. In this talk, I address a question which asks a convergence of l_p-product spaces for two convergent sequences of metric measure spaces. For the box topology, this problem is easy. However, for the concentration topology, this problem is harder. The main result gives the answer of this problem for the concentration topology.

19 Naotaka Kajino (Kobe Univ.) The Laplacian on some round Sierpiński carpets and Weyl's asymptotics for its eigenvalues 15

Summary: This talk will present the speaker's recent results on a "canonical" Laplacian on some *round Sierpiński carpets* (RSCs), i.e., subsets of $\mathbb{C} \cup \{\infty\}$ homeomorphic to the standard Sierpiński carpet with complement consisting of disjoint open disks. On the *Apollonian gasket*, Teplyaev (2004) had constructed a canonical Dirichlet form as one with respect to which the coordinate functions are harmonic, and the speaker later proved its uniqueness and an explicit expression in terms of the circle packing structure of the gasket. This last expression of the Dirichlet form makes sense on general circle packing fractals, including RSCs, and defines a "canonical" Laplacian on such fractals. Moreover, with the knowledge of some combinatorial structure of the fractal it is also possible to prove Weyl's eigenvalue asymptotics for this Laplacian.

20 Kota Hattori (Keio Univ.) On spectral convergence of vector bundles 15

Summary: In this talk I consider the continuity of the eigenvalues of the connection Laplacian of G-connections on vector bundles over Riemannian manifolds. To show it, I introduce the notion of the asymptotically G-equivariant measured Gromov–Hausdorff topology on the space of metric measure spaces with isometric G-actions, and apply it to the total spaces of principal G-bundles equipped with G-connections over Riemannian manifolds.

21 Koichi Nagano (Univ. of Tsukuba) Volume pinching theorems for CAT(1) spaces 15

Summary: We examine volume pinching problems of CAT(1) spaces. We characterize a class of compact geodesically complete CAT(1) spaces of small specific volume. We prove a sphere theorem for compact CAT(1) homology manifolds of small volume. We also formulate a criterion of manifold recognition for homology manifolds on volume growths under an upper curvature bound.

13:00–13:10 Presentation Ceremony for the 2018 MSJ Geometry Prize

13:15–14:15 Award Lecture for the 2018 MSJ Geometry Prize

Yuji Odaka (Kyoto Univ.)* Collapsing Kähler–Einstein metrics and moduli compactification

Summary: It is known that any compact Riemann surface admits a unique constant Gaussian curvature (Hermitian) metrics. Extending it to higher dimensional complex varieties, there is a notion of Kähler–Einstein metrics which is canonical (unique), characterized by constancy of Ricci curvature. The sign of Ricci curvature crucially controls the geometric properties, especially when we take limit spaces.
In our studies done while ago, we worked on relations between such metrics and birational algebraic geometry, and then algebra-geometric compactification of moduli space of Fano varieties, positive Ricci curvature case. The focus of this talk will be, among others, on the case Ricci curvature is zero, so-called "Calabi–Yau metrics" or Ricci-flat Kähler metrics. Our recent work with Yoshiki Oshima (arXiv:1810.07685) provides a moduli-theoretic framework for the collapsing of Ricci-flat Kähler metrics by certain explicit compactifications of classical moduli varieties. The speaker originally called the obtained compactification "tropical geometric compactification" and the joint work largely develops the theory.
On the way, what we observe in various forms repeatedly are two general deep natures of Kähler–Einstein metrics, its "algebraicity" (or "algebro-geometricity") and "minimality".

March 19th (Tue) Conference Room V

9:40–11:40

22 Johannes Jaerisch (Shimane Univ.) Katsuhiko Matsuzaki (Waseda Univ.) Weighted cogrowth formula for free groups 15

Summary: We investigate the relationship between geometric and analytic indices for quotients of the Cayley graph of the free group $\mathrm{Cay}(F_n)$. Our main result, which generalises Grigorchuk's cogrowth formula to variable edge lengths, provides a formula relating the bottom of the spectrum of weighted Laplacian on $G\backslash\mathrm{Cay}(F_n)$ to the Poincaré exponent of G. Our main tool is the Patterson–Sullivan theory for metric trees.

23 Takuro Yasui (Waseda Univ.) Runa Umezawa (Waseda Univ.) Yohei Komori (Waseda Univ.) Area formula for cyclic polygon in classical geometry 15

Summary: We prove that if $n \geq 5$, there is no area formula of the general hyperbolic and spherical cyclic n-gon written in terms of arithmetic operations and k-th roots of its side lengths.

24 Shigehiro Sakata (Univ. of Miyazaki) Critical points of Riesz potential and characterization of regular triangles 15

Summary: It is known that the centroid, the incenter and the Chebyshev center of a body in Euclidean space are obtained as critical points of the Riesz potential of the body. Applying this fact to a triangle in Euclidean plane, we review and generalize the classical theorem that if at least two of the centroid, the incenter and the circumcenter of a triangle coincide, then the triangle has to be regular.

25 Tomoshige Yukita (Waseda Univ.) Hyperbolic 4-manifolds constructed from a Napier cycle 10

Summary: In order to construct hyperbolic 4-manifolds, Kolpakov and Slavich introduced the coloring technique of right-angled 4-polytopes. In this talk, we consider the hyperbolic Coxeter 4-polytope defined by a Napier cycle and construct hyperbolic 4-manifolds by using the coloring technique.

26 Jumpei Gohara (Tokyo Univ. of Sci.)
Yuji Hirota (Azabu Univ.)
Keisui Ino (Tokyo Univ. of Sci.)
Akifumi Sako (Tokyo Univ. of Sci.)
Quantized algebra 15

Summary: We propose a new formulation of quantized algebra by using category theory. There are several ways of quantization of algebra, for example, deformation quantization, matrix regularization and so on. For the unified description of them, we define quantization of an algebra as a functor. A sequence of some categories of algebras is a sequence of corresponding quantized algebras, and the limit of them is a classical algebra. We discuss deformation quantization and matrix regularization closely as examples.

27 Henrique de Campos Affonso (Univ. of Tokyo)
Bow varieties for the symplectic group 15

Summary: We define bow varieties for the symplectic group as quotients of some appropriate vector spaces by products of general linear and orthogonal groups. If we impose the balanced condition, we have equidimensionality of fibers of their factorization maps, and that these varieties are normal. We expect these two properties can be used to obtain a relationship between these varieties and Coulomb branches of quiver gauge theories of affine type C.

28 Noriaki Ikeda (Ritsumeikan Univ.)
On the relation of Lie algebroids to constrained Hamiltonian systems and their BV/BFV formulation 15

Summary: We observe that a system of irreducible, fiber-linear, first class constraints on T^*M is equivalent to the definition of a foliation Lie algebroid E over M. The BFV formulation of the constrained system is given by the Hamiltonian lift of the Vaintrob description $(E[1], Q)$ of the Lie algebroid to its cotangent bundle $T^*E[1]$. Adding a Hamiltonian to the system corresponds to a metric g on M. Consistency introduces a connection ∇ on E and one obtains the compatibility of g with (E, ρ, ∇). This leads a geometric construction of a BFV and BV-AKSZ formalism.

14:20–16:25

29 Ryohei Chihara (Univ. of Tokyo)
G_2-manifolds and the ADM formalism 15

Summary: In this talk, I introduce a Hamiltonian function on the cotangent bundle of the space of Riemannian metrics on a closed oriented 3-manifold, and show the constrained Hamiltonian system of the function produces SO(3)-invariant G_2-manifolds.

30 Masaya Kawamura (Nat. Inst. of Tech., Kochi Coll.)
Parabolic flows in the almost Hermitian geometry 15

Summary: We introduce two parabolic flows which preserve the almost pluriclosedness and the almost balancedness respectively in the almost Hermitian geometry. The first one is called an almost pluriclosed flow. We show that the flow has a unique short-time solution and also show that this flow coincides the palabolic flow called an almost Hermitian curvature flow. The second one is a parabolic flow of almost Hermitian metrics which evolves an initial metric along the second derivative of the Chern scalar curvature, which is called a scalar Calabi-type flow. We show that the flow has a unique short-time solution and also show a stability result when the background metric is quasi-Kähler with constant scalar curvature.

31 Yuto Yamamoto (Univ. of Tokyo)
Periods of tropical K3 hypersurfaces 15

Summary: Let Δ be a smooth reflexive polytope in dimension 3 and f be a tropical polynomial whose Newton polytope is the polar dual of Δ. One can construct a 2-sphere equipped with an integral affine structure with singularities by contracting the tropical K3 hypersurface defined by f. We write the complement of the singularity as $i\colon B_0 \hookrightarrow B$, and the local system of integral tangent vectors on B_0 as T. In the talk, we will give a primitive embedding of the Picard group $\mathrm{Pic}X$ of the toric variety X associated with the normal fan of Δ into $H^1(B, i_*T)$, and compute the radiance obstruction of B, which sits in the image of $\mathrm{Pic}X$. We will also discuss the relation with the asymptotic behavior of the period map of complex K3 hypersurfaces.

Summary: In this talk, I give an ε-regularity theorem for line bundle mean curvature flows. The line bundle mean curvature flow is a kind of parabolic flows to obtain deformed Hermitian Yang–Mills metrics on a given Kähler manifold and recently defined by Jacob and Yau. To establish the theorem, I will introduce a scale invariant monotone quantity and as the critical point of this quantity self-shrinker solutions of the line bundle mean curvature flow are defined. The Liouville type theorem for self-shrinkers will be also given and it plays an important role in the proof of the ε-regularity theorem.

Summary: We show a method to construct a special Lagrangian submanifold L' from a given special Lagrangian submanifold L in a Calabi–Yau manifold with the use of generalized perpendicular symmetries. We use moment maps of the actions of Lie groups, which are not necessarily abelian. By our method, we construct some non-trivial examples in non-flat Calabi–Yau manifolds T^*S^n which equipped with the Stenzel metrics.

Summary: We investigate the Hamiltonian-stability of Lagrangian tori in the complex hyperbolic space $\mathbb{C}H^n$. We consider a standard Hamiltonian T^n-action on $\mathbb{C}H^n$, and show that every Lagrangian T^n-orbits in $\mathbb{C}H^n$ is H-stable when $n \leq 2$ and there exist infinitely many H-unstable T^n-orbits when $n \geq 3$. On the other hand, we prove a monotone T^n-orbit in $\mathbb{C}H^n$ is H-stable and rigid for any n. Moreover, we see almost all Lagrangian T^n-orbits in $\mathbb{C}H^n$ are not Hamiltonian volume minimizing when $n \geq 3$ as well as the case of $\mathbb{C}^n$ and $\mathbb{C}P^n$.

Summary: LCK manifold is said to be a Vaisman manifold if Lee form is parallel with respect to Levi–Civita connection. In this talk, we prove that if a solvmanifold such that the commutator of the solvable Lie group is abelian has a Vaisman structure, then it is Kodaira–Thurston manifold. As corollary, a solvmanifold such that the solvable Lie group is meta-abelian has no Vaisman structures.

16:40–17:40 Talk Invited by Geometry Section

Hiroaki Ishida (Kagoshima Univ.) Complex manifolds with maximal torus actions and their foliations

Summary: We say that an effective action of a compact torus G on a connected smooth manifold M is maximal if there exists a point $x \in M$ such that $\dim G + \dim G_x = \dim M$. We give a complete classification of compact connected complex manifolds with maximal torus actions, in terms of combinatorial objects, which are triples $(\Delta, \mathfrak{h}, G)$ of nonsingular complete fan Δ in $\mathfrak{g}$, complex vector subspace $\mathfrak{h}$ of $\mathfrak{g}^{\mathbb{C}}$ and compact torus G satisfying certain conditions.

On the other hand, a compact connected complex manifold equipped with a compact torus action has a holomorphic foliation coming from the torus action. We discuss a classification of compact connected complex manifolds with maximal torus actions up to transverse equivalence. If time permits, we also discuss the basic cohomology and basic Dolbeault cohomology of such manifolds.

Complex Analysis

March 17th (Sun) Conference Room II

9:45–11:50

1 Saburou Saitoh * (Gunma Univ.*/Inst. of Reproducing Kernels)
Wolfgang W. Däumler
Horn torus models for the Riemann sphere from the viewpoint of division by zero (draft) 15

Summary: In this talk, we will introduce beautiful horn torus models by Puha and Däumler for the Riemann sphere in complex analysis from the viewpoint of the division by zero.
Contents: Division by zero calculus, Horn torus models by Puha and Däumler, Properties of horn torus models and Conformal mapping from the plane to the horn torus.

2 Masaaki Ito
Fumio Maitani (Kyoto Inst. Tech.*)
Masakazu Shiba (Hiroshima Univ.*)
The change of the Schiffer span of a certain symmetric horizontal slit region under degeneration 15

Summary: We first find the Schiffar span of a $2n$-ply connected horizontal slit region which is symmetric in the real and the imaginary axis, Then we let the mutually symmetric two slits converge to a single slit on the real axis, and obtain a $(2n-1)$-ply connected region. We compare the Schiffer spans of these regions We also give a numerical example for the case of doubly connected regions.

3 Katsuya Ishizaki (Open Univ. of Japan)
On meromorphic solutions of some algebraic difference equations 15

Summary: The difference equation $(*)(\Delta f(z))^2 = A(z)(f(z)f(z+1) - B(z))$ where $A(z)$ and $B(z)$ are meromorphic functions, is investigated. If (*) possesses two distinct transcendental meromorphic solutions, it is shown that these solutions satisfy an algebraic relation, and that their growth behaviors are almost same in the sense of Nevanlinna under some conditions.

4 Katsuhiko Matsuzaki (Waseda Univ.)
Huaying Wei (Jiangsu Normal Univ.)
Asymptotic BMO Teichmüller space 15

Summary: We show that the quotient of the BMO Teichmüller space by the VMO Teichmüller space has a natural complex structure modeled on the quotient Banach space. Then, we introduce a certain complete translation-invariant metric on the BMO Teichmüller space and its quotient. By using these structures, we investigate the space of chord-arc curves in the BMO Teichmüller space.

5 Atsushi Kameyama (Gifu Univ.)
Cantor Julia sets of rational maps 15

Summary: We prove: For a generic hyperbolic rational map f of degree d whose Julia set is Cantor, there is a simply connected domain U such that $f^{-1}(U) \subset U$ and $f^{-1}(U)$ consists of d connected components. Using this, we show that the shift locus is connected.

6 Mitsuhiro Shishikura (Kyoto Univ.)
David Martí Pete (Polish Academy of Sci.)
Oscillating wandering domains for a transcendental entire function of class $\mathcal{B}$ 15

Summary: C. Bishop has introduced a technique called quasiconformal folding, and as an application, constructed a transcendental entire function of class $\mathcal{B}$ (with bounded singular values) having an oscillating wandering domain. We propose a new and simplified construction which uses quasiconformal mappings but not Bishop's quasiconformal folding. With our method, we can show that the obtained function has finite order.

Summary: When a family of Beltrami differentials is given, the corresponding quasiconformal mappings are differentiable with respect to the parameter, under a suitable condition. We propose a new approach for the proof with a weaker hypothesis. The proof is related to the deformation of cross-ratio of 4 points and double covering torus. As a by-product, we obtain an integro-differential equation for the elliptic modular function.

14:15–15:20

Summary: We study proper holomorphic mappings between generalized complex pseudo-ellipsoids, especially different dimensions. Under some regularity condition on the boundary, such mapping is classified into special kind of mapping whose components are monomials.

Summary: Let $\mathbb{B}_X$ be a bounded symmetric domain realized as the unit ball of a JB*-triple X. Recently, Chu, Hamada, Honda and Kohr introduced the concept of a Bloch function on a bounded symmetric domain which can be infinite dimensional and derived some basic properties of the Bloch space $\mathcal{B}(\mathbb{B}_X)$ and composition operators in this setting, generalising several finite dimensional results. In this talk, we refine and develop some results in Chu, Hamada, Honda and Kohr by extending finite dimensional results on Bloch spaces and composition operators, as well as answering two open questions by Allen and Colonna.

Summary: In this talk, we continue the work related to embedding univalent mappings in Loewner chains on the unit ball $\mathbb{B}^n$ in $\mathbb{C}^n$. We always assume that $n \geq 2$ and we obtain approximation properties of various families of normalized univalent mappings f on $\mathbb{B}^n$ by automorphisms of $\mathbb{C}^n$ whose restrictions to $\mathbb{B}^n$ have the same geometric property of f.

Summary: In this talk, we always assume that $n \geq 2$ and we show that every automorphism restricted to a bounded domain in $\mathbb{C}^n$ extends to a quasiconformal diffeomorphism of class C^∞ from $\mathbb{C}^n$ onto $\mathbb{C}^n$, which is equal to the identity mapping outside some ball. Next, we give a variational result for A-normalized univalent subordination chains, for $A \in L(\mathbb{C}^n)$ with $m(A) > 0$. Using these results, we shall deduce that every mapping which has A-parametric representation on $\mathbb{B}^n$ can be approximated locally uniformly on $\mathbb{B}^n$ by mappings which have A-parametric representation on $\mathbb{B}^n$ and admit extensions, on one hand, to automorphisms of $\mathbb{C}^n$ and, on the other hand, to smooth quasiconformal diffeomorphisms of class C^∞ from $\mathbb{C}^n$ onto $\mathbb{C}^n$, which are equal to the identity mapping outside some ball, when $m(A) > 0$.

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

Ikkei Hotta (Yamaguchi Univ.) Construction of quasiconformal extensions by means of Loewner's equation

Summary: Loewner Theory, which goes back to the parametric representation of univalent functions introduced by Loewner in 1923, has recently undergone significant development in various directions, including Schramm's stochastic version of the Loewner differential equation and the new intrinsic approach suggested by Bracci, Contreras, Diaz-Madrigal and Gumenyuk. The relation between Loewner's equation and the quasiconformal extensions of conformal mappings has been indicated by Becker in 1972. Recently His result was recently extended to the framework of modern Loewner theory by Gumenyuk, Prause and Hotta. In this talk, we firstly review the theory of Loewner equations in classical and modern treatments. Then we discuss some recent results on this topics.

March 18th (Mon) Conference Room II

9:45–11:45

12 Katsusuke Nabeshima (Tokushima Univ.)
Shinichi Tajima (Niigata Univ.) Bruce–Roberts Milnor numbers of generic linear functions ····· 15

Summary: We consider Bruce–Roberts Milnor numbers, on isolated hypersurece singularities, in the context of symbolic computation. We describe, as an application of logarithmic vector fields, an algorithm for computing Bruce–Roberts Milnor numbers. We give a relation between a Bruce–Roberts Milnor number and a generic linear function.

13 Katsusuke Nabeshima (Tokushima Univ.)
Shinichi Tajima (Niigata Univ.) On the computation of Chern–Schwartz–MacPherson classes ····· 15

Summary: We introduce an algorithm for computing Chern–Schwartz–MacPherson classes in the context of symnolic computation. The key idea of the approach is the use of parametric Gröbner bases.

14 Soya Kirii (Yamagata Univ.) The condition the maximal ideal cycle and the fundamental cycle of normal complex hypersurface singularity of the form $z^n = y(x^a + y^b)$. ····· 10

Summary: For the maximal ideal cycle M and the fundamental cycle Z of the resolution of nomal complex surface singularities, $M \geq Z$ hols. H. Laufer showed a example M does not coincident with Z in any resolution of the form $z^2 = y(x^4 + y^6)$. We interested in the condition M equals Z of normal complex surface singularities. In this talk, we report the condition that M equals Z in the minimal good resolution of the normal hypersurface singularity of the form $z^n = y(x^a + y^b)$.

15 Masataka Tomari (Nihon Univ.)* On the finiteness of weight types of weighted homogeneous complex singularities for a positive geometric genus ····· 15

Summary: The following finiteness theorems holds by recent progress of MMP theorem and our studies of singularities by filtered blowing-ups;
Theorem 1. Let f be a weighted homogeneous d-dimensional complex singularity with $a(f) = a(C[x]/f) \geq 0$. Here $a(C[x]/f)$ is the Goto–Watanabe's a-invariant for graded ring. We assume $\{f = 0\} - \{0\}$ has rational singularities. Then for a fixed value $\alpha = a(f)$, the possible weight types are finite.
Theorem 2. Let R be a Gorenstein normal graded complex analytic singularity with geometric genus $p_g(R) \geq 1$. We assume $Spec(R) - V(R_+)$ has rational singularites. For fixed embedding dimension and p_g, $a(R)$ is bounded from above.

16 Tomohiro Okuma (Yamagata Univ.) Weighted homogeneous surface singularities homeomorphic to Brieskorn complete intersections 15

Summary: Fixing a topological type of a Brieskorn complete intersection surface singularity, we study the singularities which realizes the maximal geometric genus or minimal maximal ideal cycle.

17 Atsushi Yamamori (Kogakuin Univ.) Two variations of Boas–Fu–Straube's deflation identity 15

Summary: In this talk, we study deflation type identities of the Bergman kernels, which was initiated by Boas, Fu and Straube in 1999. We establish two variations of deflation type identities for a certain class of domains which is so-called the Roos domains. Our main result includes deflation type identities due to Boas–Fu–Straube and Beberok as special cases.

18 Takeo Ohsawa (Nagoya Univ.)$^{\flat}$ Analyticity criterion for functions by the existence of a complete Kähler metric on the complement of the graph 15

Summary: Let D be a pseudoconvex domain in $\mathbb{C}^n$ and let $f : D \to \mathbb{C}$ be a continuous function. F. Hartogs (1909) proved that f is holomorphic if and only if the complement of its graph $G_f := \{(z, f(z)); z \in D\}$ in $D \times \mathbb{C}$ is pseudoconvex. N. Shcherbina (2005) has shown that f is holomorphic if and only if G_f is pluripolar. It will be proved that f is holomorphic if and only if the complement of G_f admits a complete Kähler metric.

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

Takato Uehara (Okayama Univ.) Dynamical systems on complex surfaces

Summary: The entropy measures the complexity of a dynamical system, and if the entropy is positive then the system exhibits a chaotic behavior. When a dynamical system with positive entropy is given by an automorphism of a compact complex surface, it is known from the Enriques–Kodaira classification that the surface is either a complex torus, an Enriques surface, a K3 surface or a rational surface. In this talk, we will restrict our attention to K3 surfaces and rational surfaces, and give a survey on complex dynamical systems.

Functional Equations

March 17th (Sun) Conference Room III

9:15–12:00

1 Hideaki Izumi (Chiba Inst. of Tech.) How to solve iterated functional equations by using dimensioned numbers · · · · · 10

Summary: We consider iterative functional equations of the type $f^n(x) = g(x)$. We develop the theory of dimensioned numbers, which are suitable for representing iterated power functions or iterated exponential functions, and try to solve the equations.

2 Akihito Ebisu (Chiba Inst. of Tech.) Invariants of difference equations and transformation formulae for hypergeometric functions · · · · · 10

Summary: We introduce invariants of linear difference equations. Moreover, using these invariants, we develop a systematic method for constructing transformation formulae for hypergeometric functions. By applying this method to Gauss's hypergeometric function, not only known formulae, such as algebraic transformation formulae and transformation formulae of special values, but also new-type transformation formulae are obtained.

3 Yoshiaki Goto (Otaru Univ. of Commerce) Finite irreducible monodromy group for Lauricella's F_C · · · · · 10

Summary: I study the monodromy group for Lauricella's hypergeometric function F_C. In this talk, I would like to give finiteness conditions of the monodromy group. It is a generalization of the finiteness conditions of the monodromy group for Appell's F_4, which are given by M. Kato (1997).

4 Kanam Park (Kobe Univ.) A certain generalization of q-hypergeometric functions and their related monodromy preserving deformation · · · · · 10

Summary: Tsuda obtained a monodromy preserving deformation which has special solutions represented by a generalization of the Gauss hypergeometric function. Our purpose is to obtain a q-analog of the result. We define a series $\mathcal{F}_{N,M}$ as a certain generalization of q-hypergeometric functions. We talk about a monodromy preserving deformation which admits particular solutions in terms of the function $\mathcal{F}_{N,M}$.

5 Nobuki Takayama (Kobe Univ.)
Saiei-Jaeyeong Matsubara-Heo (Kobe Univ.) An algorithm for computing intersection numbers of twisted cohomology groups · · · · · 10

Summary: We explain an algorithm of computing cohomology intersection numbers associated to a hypergeometric type connection. We will see that the inverse of the cohomology intersection matrix is a rational function which satisfies a certain Pfaff system whose rational solutions are up to constant mmultiplication equal to the inverse of the cohomology matrix. Combining this with the theory of GKZ hypergeometric system, we can completely determine the intersection matrix.

6 Takashi Aoki (Kindai Univ.)
Shofu Uchida (Kindai Univ.) Voros coefficients at the origin of the generalized hypergeometric differential equation with a large parameter · · · · · 10

Summary: The Voros coefficients of the origin are defined and their explicit forms are given for the generalized hypergeometric differential equation of ${}_3F_2$ with a large parameter.

Summary: We consider the Cauchy problem for linear hyperbolic systems with characteristic roots of constant multiplicities atmost double. We show the smooth continuation of eigenvectors of double characteristic roots along each characteristic strips (This is new.) By this, we can obtain the admissible data space corresponding to the regularity of the coefficients when the coefficients depend only on the time variable. (This is not new.)

Summary: This talk deals with Hyers–Ulam stability of second-order linear difference equations

$$\Delta_h^2 x(t) + \alpha \Delta_h x(t) + \beta x(t) = f(t), \quad t \in h\mathbb{Z},$$

where $\Delta_h x(t) = (x(t+h) - x(t))/h$ and $h\mathbb{Z} = \{hk | \, k \in \mathbb{Z}\}$. The purpose of this talk is to find an explicit HUS constant for the second-order linear difference equations.

Summary: We consider the bifurcation problems of nonlinear ordinary differential equations with nonlinear diffusion term and the oscillatory nonlinearities. By using a generalized time-map method, λ is parameterize by the maximum norm $\alpha = \|u_\lambda\|_\infty$ of the solution u_λ associated with λ as $\lambda = \lambda(\alpha)$. Moreover, $\lambda(\alpha)$ is continuous for $\alpha > 0$. We are interested in the effect of nonlinear diffusion and oscillatory nonlinear term to the asymptotic behavior of $\lambda(\alpha)$ as $\alpha \to \infty$ and $\alpha \to 0$.

Summary: We report on the Rellich–Leray inequality with optimal constant for axisymmetric and solenoidal vector fields in $\mathbb{R}^N$. This is a vector field version of the Rellich inequality (1953) with the best value of constant factor. We aim to see how the best constant changes if the unknown vector fields are constrained by the divergence-free condition with axial symmetry.

Summary: We consider the inequality which has a dual relation with the logarithmic Sobolev inequality of Beckner type. By using the relative entropy, we identify the sharp constant and the extremal of this inequality. Moreover, we derive the logarithmic uncertainty principle like Beckner's one.

Summary: We consider a maximization problem on the Trudinger–Moser inequality with Lebesgue term. As known result, a maximizer of the maximization problem on the classical Trudinger–Moser inequality exists. In this talk, we show that the attainability changes depending on the condition of the Lebesgue term.

Summary: We consider a bounded domain Ω of $\mathbb{R}^N$ with C^2 boundary. Then we establish the extension of Hardy's inequality with weights using the function of distance from the boundary of Ω. Also we consider the variational problem associated with the weighted Hardy's inequality involving compact perturbation. Then we study the infimum of the variational problem and the existence or non-existence of minimizer for the variational problem.

14:15–16:15

14 Kazuyuki Yagasaki (Kyoto Univ.)
Tomasz Stachowiak
Bifurcations of radially symmetric solutions in a coupled elliptic system with critical exponents · · · · · 10

Summary: We consider a system of coupled elliptic partial differential equations with critical growth in $\mathbb{R}^d$ for $d = 3, 4$ and study bifurcations of three families of radially symmetric, bounded solutions. We reduce the problems of the three families to those of three symmetric homoclinic orbits in a four-dimensional reversible system of ordinary differential equations and show that transcritical or pitchfork bifurcations of the three families occur at infinitely many parameter values.

15 Shingo Takeuchi (Shibaura Inst. of Tech.)
Exact solutions and asymmetry for a nonlocal boundary value problem · · · · · 10

Summary: We will give exact solutions of a nonlocal boundary value problem with respect to the inviscid primitive equations in terms of generalized trigonometric functions. Moreover, we will show the asymmetry of the solutions by calculation corresponding to the evaluation of the median of the beta distribution.

16 Kenichiro Umezu (Ibaraki Univ.)
Uriel Kaufmann (Univ. Nacional de Córdoba)
Humberto Ramos Quoirin (Univ. de Santiago de Chile)
Exact multiplicity of positive solutions for an indefinite concave Robin bvp · · · · · 10

Summary: We investigate the structure of the nonnegative solutions set of an indefinite concave elliptic problem with Robin boundary conditions. We establish several qualitative properties of nontrivial nonnegative solutions of the problem. In particular, we prove a positivity property, which enables us to show that this problem has a subcontinuum of positive solutions. Furthermore, we prove an exact multiplicity result for nontrivial nonnegative solutions. Our approach combines mainly bifurcation techniques, the sub-supersolutions method, and a priori lower and upper bounds.

17 Toshiaki Yachimura (Tohoku Univ.)
Domain perturbation and singular perturbation of the coefficients for a two-phase eigenvalue problem · · · · · 10

Summary: In this talk, we consider the asymptotic behavior for the principal eigenvalue of an elliptic operator with piecewise constant coefficients. This problem was first studied by Friedman in 1980. We show how the geometric shape of the interface affects the asymptotic behavior for the principal eigenvalue. This is a refinement of the result by Friedman.

18 Lorenzo Cavallina (Tohoku Univ.)
Toshiaki Yachimura (Tohoku Univ.)
On a two-phase Serrin-type overdetermined problem and its numerical computation · · · · · 10

Summary: In this talk, we consider an overdetermined problem of Serrin-type with respect to an operator in divergence form with piecewise constant coefficients. We give sufficient condition for unique solvability near radially symmetric configurations by means of a perturbation argument relying on shape derivatives and the implicit function theorem. This problem is also treated numerically, by means of a steepest descent algorithm based on a Kohn–Vogelius functional.

19 Yuika Kajihara (Kyoto Univ.)
Mitsuru Shibayama (Kyoto Univ.)
Variational proof of the existence of brake orbits in the planar 2-center problem · · · · · 10

Summary: The restricted three-body problem is an important subject that deals with significant issues referring to scientific fields of celestial mechanics, such as analyzing asteroid movement behavior and orbit designing for space probes. The 2-center problem is its simplified model. The goal of this paper is to show the existence of brake orbits, which means orbits whose velocities are zero at some times, under some particular conditions in the planar 2-center problem by using variational methods.

20 Jun Okamoto (Univ. of Tokyo) Random discretization of O'Hara knot energy ····· 10

Summary: We considered the random discretization of O'hara energy. O'hara energy is the energy defined for a knot, in the case of a specific index, it is called Moebius energy. Due to energy invariance under Moebius transformation, it is possible to show the existence of minimizer in the prime knot. Moreover, Kim and Kusner defined the discretization of Moebius energy for polygons in '93, and S. Scholtes proved its Gamma convergence in '14. We defined the random discretization of the weighted O'hara energy and show that the local uniform convergence and the compactness of our energy.

21 Simon Blatt (Salzburg Univ.)
Aya Ishizeki (Chiba Univ.)
Takeyuki Nagasawa (Saitama Univ.)
A Möbius invariant discretization Γ-converging to the Möbius energy ····· 10

Summary: We introduce a new discretization of the Möbius energy. The Möbius energy was named after its invariant property under Möbius transformations of the surrounding space. Known discretizations lose the Möbius invariance or Γ-convergence. This new discretization has the invariance, and converges to the original energy minus the energy of right circles in the sense of Γ-convergence under very natural assumptions. The starting point for this new discretization is the cosine formula of Doyle and Schramm.

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

Shingo Kamimoto (Hiroshima Univ.) Resurgent functions and convolution products

Summary: Resurgent analysis originates from the work "Les fonctions résurgentes" by J. Écalle in 1981. As it was revealed in his works, the framework of his theory has various of applications in the analysis of differential equations, vector fields, dynamical systems, multiple zeta values and so on. Resurgent analysis is built on the basis of the theory of resurgent functions. However, even fundamental properties of such functions are not understood well.
In this talk, we study the singularity structure of resurgent functions in the Borel plane through the analysis of convolution products of analytic functions. As an application, we discuss the resurgence of formal series solutions of nonlinear ordinary differential equations.

March 18th (Mon) Conference Room Ⅲ

9:15–12:00

22 Masato Kimura (Kanazawa Univ.)
Patrick van Meurs (Kanazawa Univ.)
Precise characterisation of the minimiser of interaction energies ····· 10

Summary: We consider both the minimization of a class of nonlocal interaction energies over non-negative measures with unit mass and a class of singular integral equations of the first kind of Fredholm type. Our setting covers applications to dislocation pile-ups, contact problems, fracture mechanics and 1D log gases. Our main result shows that both the minimization problems and the related singular integral equations have the same unique solution, from which we infer new regularity results on the minimizer of the energy and new positivity results on the solutions to singular integral equations.

23 Kengo Terai (Waseda Univ.) Uniqueness structure for weakly coupled systems of ergodic problems for Hamilton–Jacobi equations ····· 10

Summary: Recently, H. Mitake and H. V. Tran have provided a new and simple way to investigate the structure of viscosity solutions for a single ergodic problem of Hamilton–Jacobi equation. In this talk, as a generalization of this result, we address a uniqueness structure for a weakly coupled system. In particular, we study comparison principle with respect to a generalized Mather measure. To get the main result, it is important to construct Mather measures effectively. Nonlinear adjoint methods enable us to overcome this difficulty.

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

Summary: The global equicontinuity estimate on L^p-viscosity solutions of parabolic bilateral obstacle problems with unbounded ingredients is established when obstacles are merely continuous. The existence of L^p-viscosity solutions is established via approximation of given datum. The local Hölder continuity on the space derivatives of L^p-viscosity solutions is shown when the obstacles belong to $C^{1,\beta}$, and $p > n + 2$.

25 Koichi Taniguchi (Chuo Univ.) Vladimir Georgiev (Univ. Pisa) Gradient estimates for heat equation in an exterior domain ····· 10

Summary: This talk is concerned with gradient estimates for the Dirichlet problem of heat equation in the exterior domain of a compact set. Our results describe the time decay rates of the derivatives of solutions to the Dirichlet problem.

26 Shigeru Sakaguchi (Tohoku Univ.) Some characterizations of parallel hyperplanes by a stationary isothermic surface in multi-layered heat conductors ····· 10

Summary: We consider the heat diffusion in the whole space consisting of three layers with different constant conductivities, where initially the above two layers have temperature 0 and the below layer has temperature 1. Under some appropriate conditions, it is shown that, if either the interface between the above two layers and the below layer is a stationary isothermic surface or there is a stationary isothermic surface in the middle layer near the below layer, then the two interfaces must be parallel hyperplanes.

27 Yuki Kaneko (Waseda Univ.) Hiroshi Matsuzawa (Numazu Nat. Coll. of Tech.) Yoshio Yamada (Waseda Univ.) Asymptotic profiles of solutions and propagating terrace for a free boundary problem of nonlinear diffusion equation with positive bistable nonlinearity ····· 10

Summary: We consider a free boundary problem for a reaction-diffusion equation with positive bistable nonlinearity. This problem may be applied to model the spreading of biological species, where unknown functions are population density and spreading front of the species.
Kawai and Yamada (2016) found multiple spreading phenomena to the problem. It is possible to show that the spreading speed and profiles of solutions to the free boundary problem are determined by Semi-wave problem (SWP) if it has a unique solution pair. Otherwise if (SWP) has no solutions, a terraced profile of a solution to the free boundary problem is observed by numerical simulations. We will show that, under a suitable condition, the solution converges to so called a propagating terrace as time tends to infinity.

28 Junyong Eom (Tohoku Univ.) Kazuhiro Ishige (Univ. of Tokyo) Large time behavior of ODE type solutions to nonlinear diffusion equations ····· 10

Summary: In this talk, we obtain the precise description of the large time behavior of the solution and reveal the relationship between the behavior of the solution and the diffusion effect the nonlinear diffusion equation has.

29 Kotaro Hisa (Tohoku Univ.) Kazuhiro Ishige (Univ. of Tokyo) Solvability of the heat equation with a nonlinear boundary condition ····· 10

Summary: In this talk we obtain necessary conditions and sufficient conditions for the solvability of the problem

$$\text{(P)} \qquad \partial_t u = \Delta u, \quad x \in \mathbf{R}^N_+, \ t > 0, \quad \partial_\nu u = u^p, \quad x \in \partial\mathbf{R}^N_+, \ t > 0$$

with the initial condition

$$u(x, 0) = \mu(x) \geq 0, \quad x \in D := \overline{\mathbf{R}^N_+},$$

where $N \geq 1$, $p > 1$ and μ is a nonnegative measurable function in $\mathbf{R}^N_+$ or a Radon measure in $\mathbf{R}^N$ with $\operatorname{supp}\mu \subset D$. Our sufficient conditions and necessary conditions enable us to identify the strongest singularity of the initial data for the solvability for problem (P).

Summary: We study existence and nonexistence of a local in time solution for the weakly coupled reaction-diffusion system $\partial_t u = \Delta u + g(v)$, $\partial_t v = \Delta v + f(u)$ in $\mathbb{R}^N \times (0,T)$, where $N \geq 1$, $T > 0$ and f and g grow rapidly. We mainly consider the case where f and g are exponential or superexponential. We show that if the nonnegative initial data satisfies a certain integrability condition, then the local in time solution exists. Moreover, we show that there exists an initial data not satisfying the integrability condition such that the solution does not exist.

Summary: In this talk, we shall consider local and global existence of a nonlinear diffusion equation of porous medium type with a nonlinear source. We obtain the estimate of the blow-up time and blow-up rate of solutions.

Summary: In this talk, we consider doubly nonlinear parabolic equations p-Sobolev flow type, which include the classical Yamabe flow concerning so-called Yamabe problem on a bounded domain in Euclidean space in the case $p = 2$. We present some regularity results for their equations.

Summary: We consider a family of axisymmetric hypersurfaces evolving by its mean curvature with driving force. However, the initial hypersurface is oriented singularly at origin. We investigate this problem by level set method and give some criteria to judge whether the interface evolution is fattening or not. In the end, we can classify the solutions in the plane into three categories and provide the asymptotic behavior in each category. Our main tools in this paper are level set method and intersection number principle.

Summary: We study the surface diffusion flow governing a curve on a half line. Two boundary conditions are imposed on the boundary. The second boundary condition is nonlinear. This problem was initiated by W. W. Mullins in 1957. We establish existence and uniqueness of the self-similar solution to our problem. Moreover, we discuss a stability result of self-similar solution.

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

Nicola Fusco (Univ. di Napoli) Asymptotic stability of the gradient flow of some nonlocal energies

Summary: I will present some recent results obtained in collaboration with Massimiliano Morini and Vesa Julin concerning the local in time existence and the asymptotic stability of the evolution equation

$$V_t = \Delta_{\Gamma_t}(H_t - W(E(u_t))).$$

Here V_t denotes the normal velocity at time t of an evolving set F_t compactly contained in a given open set $\Omega \subset \mathbb{R}^3$, Δ_{Γ_t} is the Laplace–Beltrami operator on $\Gamma_t = \partial F_t$, H_t is the scalar mean curvature of Γ_t and $E(u_t) = (\nabla u_t + (\nabla u_t)^T)/2$ is the symmetric part of the gradient of the minimizer $u_t : \Omega \setminus F_t \mapsto \mathbb{R}^3$ of the following linear elasticity problem

$$\min\left\{ \int_{\Omega\setminus F_t} W(E(w(x)))\,dx : w \in H^1(\Omega \setminus F_t;\mathbb{R}^3),\ w = u_0 \text{ on } \partial\Omega \right\},$$

where for a 3×3 symmetric matrix A, we have set $W(A) = \mu|A|^2 + \lambda[Tr(A)]^2/2$ and $\mu > 0, \lambda + \mu > 0$. The equation above has been proposed to model the evolution of a material void F_t inside an elastic material under the action of a chemical potential acting on the boundary of F_t. The results I will present are new also in the special case $u_0 \equiv 0$, hence $u_t \equiv 0$, when the equation reduces to the surface diffusion equation

$$V_t = \Delta_{\Gamma_t} H_t.$$

March 19th (Tue) Conference Room III

9:00–12:00

Summary: A kinetic equation describing mutation process in bacteria is considered. Such equation has been studied in view of the probability generating functions, however, this formulation enables us to analyse the equation via the Fourier transform, which is known to be a strong tool for kinetic equations such as the Boltzmann equation. It is shown that the Fourier-transformed equation has a characteristic function as a solution, which in turn gives a probability measure solution to the original equation. A Paley–Wiener type theorem is also shown to reveal relation of these functions and measures.

Summary: Microorganisms are known to form spatiotemporal patterns similar to those formed in the Rayleigh–Bénard model for thermal convection. Among such, Euglena gracilis form distinct patterns induced by phototaxes and sensitivity to the gradient of the light intensity.
This talk reports on microscopic light sensing in Euglena gracilis and resulting formation of macroscopic patterns of cells.

Summary: In this talk, we consider the spatially periodic Fisher-KPP equation in $\mathbb{R}$. We investigate a minimizing problem associated with the 'spreading speed' for this equation. Here the spreading speed is the asymptotic speed of an expanding front that starts from a compactly supported initial data. We introduce a condition under which equality holds in an inequality about the spreading speed derived by Nadin.

Summary: We consider a variational problem for the spreading speed $c^*(b)$ of the solutions of the equation $u_t = u_{xx} + b(x)(1-u)u$, $x \in \mathbb{R}$, $t > 0$, where the coefficient $b(x)$ is nonnegative and periodic in $x \in \mathbb{R}$ with a period $L > 0$. The solution of this equation with compactly supported, non-trivial, nonnegative initial data converges to 1 locally uniformly in $\mathbb{R}$ as $t \to \infty$. It is known that there is the spreading speed $c^*(b)$ such that the observers who move slower than $c^*(b)$ will see the solution converges to 1 and those who move faster than $c^*(b)$ will see the solution converges to 0 locally uniformly in $\mathbb{R}$ as $t \to \infty$.
In this talk, we present our results of the study of the problem of maximizing $c^*(b)$ by varying the coefficient $b(x)$ under some constraints.

Summary: This talk is concerned with a nonlinear optimization problem that naturally arises in population biology. We consider the effect of spatial heterogeneity on the total population of a biological species at a steady state, using a reaction-diffusion logistic model. Our objective is to maximize the total population when resources are distributed in the habitat to control the intrinsic growth rate, but the total amount of resources is limited. It is shown that under some conditions, any local maximizer must be of "bang-bang" type, which gives a partial answer to the conjecture addressed by Ding et al. (2010). To this purpose, we perturb the distribution of resources, and compute the first and second variations of the total population.

Summary: We investigate the behavior of positive solutions for the logarithmic diffusion equation. We are interested in the behavior of solutions which extinct in a finite time. More precisely, we prove that the re-scaled solution converges to a traveling pulse. In addition, we also discuss the behavior of solutions which converge to a monotone traveling wave.

Summary: We study the initial boundary value problem for the reaction-diffusion equation with isochronous nonlinearity. We prove that small solutions become spatially homogeneous and is subject to the ODE part asymptotically. We also discuss blow-up of an parabolic system with quadratic nonlinearity having the origin as an uniform isochronous center.

Summary: We consider the local existence and the uniqueness of a weak solution of the initial boundary value problem to a convection-diffusion equation in a uniformly local function space, where the solution is not decaying at space infinity. We show that the local existence and the uniqueness of a solution for the initial data in uniformly local Lebesgue spaces.

Summary: This talk is concerned with asymptotic behavior of solutions to a fully parabolic Keller–Segel model with signal-dependent sensitivity. In the case that the signal-dependent function is given by χ/v, Fujie established global existence of bounded classical solutions under some smallness condition for χ in 2015, and Winkler–Yokota showed asymptotic behavior of these solutions under some additional smallness condition for χ in 2018. On the other hand, in the case that the signal-dependent function is given by $\chi/(1+v)^k$ with some $k > 1$, global existence and boundedness of classical solutions were established under some smallness condition for χ (M.–Yokota, 2017); however, asymptotic behavior of these solutions is still open. The purpose of the present talk is to discuss asymptotic behavior of classical solutions under some smallness condition for χ.

Summary: In this talk we consider an effect of nonlinear diffusion on a lower bound for the blow-up time for solutions of a fully parabolic chemotaxis system. The case of linear diffusion was studied by Tao–Vernier Piro in 2016 and by Anderson–Deng in 2017. The purpose of this talk is to generalize these results to the case of nonlinear diffusion.

Summary: We consider the non-existenceof a time global solution to the Cauchy problem of a degenerate drift-diffusion system with the fast diffusion exponent. We show the solution for the fast diffusion cases with the diffusion exponent $\frac{n}{n+2} < \alpha < 1$ blows up in a finite time if the initial data satisfies certain condition involving the free energy. We also show the finite time blow up for radially symmetric case without finite moment condition. The key idea is to use the generlized version of Shannon's inequality and apply the virial low of the system.

Summary: We study the large time asymptotics of solutions to nonlinear dispersive equations which have a nonlocal and nonhomogeneous dispersive term. These equations with quadratic nonlinearities describe several models of nonlinear dispersive waves. In this talk we consider the equation with a cubic nonlinear interaction which is a critical nonlinearity for the existence of scattered states. We show that there exist modified scattered states.

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

48 Tomoyuki Tanaka (Nagoya Univ.) Local well-posedness for fourth order Benjamin–Ono type equations on the torus · · · 10

Summary: In this talk, we consider the local well-posedness for fourth order Benjamin–Ono type equations on the torus. The equation with specific coefficients is integrable and the third equation in the Benjamin–Ono hierarchy. The proof is based on the enery method with correction terms. Although correction terms can eliminate the worst term in the energy inequality, they may yield a different deriavtive loss, which is the main difficulty in our problem. In order to overcome the difficulty, we add a new correction term into the energy.

14:15–16:15

49 Mamoru Okamoto (Shinshu Univ.) Shuji Machihara (Saitama Univ.) Ill-posedness of the Cauchy problem for the Dirac–Klein–Gordon system in 1d · · · 10

Summary: We give the ill-posedness of the Cauchy problem for the Dirac–Klein–Gordon system in one dimension. This shows that the well-posedness result by Machihara et al. (2010) is optimal. Remark that our situation is different from the problems which can be applied the argument by Bejenaru–Tao (2006).

50 Satoshi Masaki (Osaka Univ.) Jun-ichi Segata (Tohoku Univ.) Kota Uriya (Okayama Univ. of Sci.) Asymptotic behavior of complex valued solutions to Klein–Gordon equation with a critical nonlinearity · · · 10

Summary: We will talk about asymptotic behavior of complex valued solutions to Klein–Gordon equation with a critical gauge-invariant nonlinearity. The main result is the existence of a solution which asymptotically behaves as a linear solution with a logarithmic phase correction.

51 Masahiro Ikeda (RIKEN/Keio Univ.) Hayato Miyazaki (Tsuyama Nat. Coll. of Tech.) Very strong instablity for standing wave solutions to the system of the quadratic Klein–Gordon equations · · · 10

Summary: We consider the instability for the standing wave solutions to the system of the quadratic Klein–Gordon equations. In the case of the nonlinear Klein–Gordon equation with power nonlinearity, stability and instability for the standing wave solutions have been extensively studied. On the other hand, in the case of our system, there is no result for the stability and instability for the standing wave solutions. In this talk, we prove the very strong instability for the standing wave solutions to our system. The proof is based on the techniques in Ohta and Todorova (2007). New ingredient is to need the mass resonance condition in two or three space dimensions whose cases are the mass sub-critical case.

52 Masahiro Ikeda (RIKEN/Keio Univ.) Motohiro Sobajima (Tokyo Univ. of Sci.) Kyouhei Wakasa (Tokyo Univ. of Sci.) On blowup solutions of semilinear wave equations and their weakly coupled systems · · · 10

Summary: In this talk we consider upper bounds of lifespan of solutions to the semilinear wave equation $\partial_t^2 u - \Delta u = |u|^p$ in $\mathbb{R}^N$. The main contribution of this work is to give an alternative proof of upper bounds of lifespan of solutions and then we found the way to prove it without the (pointwise) positivity assumption for initial data. The problem for weakly coupled systems are also discussed.

53 Sojiro Murai (Tokyo Metro. Coll. of Ind. Tech.) Strichartz estimates for magnetic Klein–Gordon equations in exterior domain and its application · · · 10

Summary: The main purpose in this talk is to show the Strichartz estimates for magnetic Klein–Gordon equations in exterior domain. The fundamental tools are Strichartz estimates for free solutions and smoothing estimates for free and perturbed solutions. Moreover by using Strichartz estimates we will show the global existence and scattering theory for the solutions to nonlinear equations with small data.

54 Kenji Nishihara (Waseda Univ.*)
Motohiro Sobajima (Tokyo Univ. of Sci.)
Yuta Wakasugi (Ehime Univ.)
Critical exponent for the semilinear wave equations with a damping increasing in the far field ····· 10

Summary: We consider the Cauchy problem of the semilinear wave equation with a damping term increasing near the spatial infinity. We determine the critical exponent, which is the threshold between the global existence and nonexistence for small initial data.

55 Tatsuya Matsui (Tohoku Univ.)♭
Ryosuke Nakasato (Tohoku Univ.)
Takayoshi Ogawa (Tohoku Univ.)
Singular limit of the magnetohydrodynamic system of damped wave type to the classical magnetohydrodynamic system ····· 10

Summary: The magnetohydrodynamic system (MHD) of damped wave type is considered as an intermediate system between the classical MHD and the Navier–Stokes–Maxwell system. We prove that the second one is obtained from the first one by taking limit in Bochner–Fourier–Lebesgue spaces. In this space we can calculate directly the symbol of the fundamental solution to damped wave and heat equations, and the results hold.

56 Hideo Kubo (Hokkaido Univ.)♭
Vladimir Georgiev (Pisa Univ.)
Kyouhei Wakasa (Tokyo Univ. of Sci.)
On the critical exponent for nonlinear wave equations with non-effective damping ····· 10

Summary: We are studying possible interaction of damping coefficients in the subprincipal part of the linear 3D wave equation and their impact on the critical exponent of the corresponding nonlinear Cauchy problem with small initial data. The main new phenomena is that certain relation between these coefficients may cause very strong jump of the critical Strauss exponent in 3D to the critical 5D Strauss exponent for the wave equation without damping coefficients.

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

Yohei Fujishima (Shizuoka Univ.)
Solvability for a semilinear heat equation without the self-similar structure

Summary: We study the local and global in time solvability for a semilinear heat equation. In particular, we consider the case where the equation does not possess the self-similar structure. By focusing on some quasi-scaling property and its invariant integral, we develop a classification theory for the existence and nonexistence of local in time solutions, and then we discuss the existence of global in time solutions for small initial data. We also study the nonexistence of global in time solutions for nonnegative initial data. These results give a generalization of the Fujita exponent for a semilinear heat equation with general nonlinearity, and classify the existence and nonexistence of global in time solutions.

March 20th (Wed) Conference Room III

9:00–12:00

57 Takuya Sato (Tohoku Univ.)♭
Takayoshi Ogawa (Tohoku Univ.)
Analytic smoothing effect for system of nonlinear Schrödinger equations with general mass resonance ····· 10

Summary: We prove that an analytic smoothing effect for a solution to the system of nonlinear Schrödinger equations for gauge invariant nonlinearities with mass resonant condition. It is shown that under rapidly decaying condition on the initial data, the solution shows a smoothing effect and is real analytic with respect to the space variable. Our theorem is an extension to the known results for the analytic smoothing effect to the nonlinear Schrödinger system with the gauge invariant setting.

Summary: We consider the following nonlinear Schrödinger equation of derivative type:

(1) $i\partial_t u + \partial_x^2 u + i|u|^2\partial_x u + b|u|^4 u = 0,\ (t,x) \in \mathbb{R}\times\mathbb{R},\ b \in \mathbb{R}.$

If $b = 0$, this equation is known as a standard derivative nonlinear Schrödinger equation (DNLS). For DNLS it is known that if the initial data $u_0 \in H^1(\mathbb{R})$ satisfies $\|u_0\|_{L^2}^2 < 4\pi$, the corresponding $H^1(\mathbb{R})$-solution is global. The main aim of this talk is to investigate global well-posedness in the energy space $H^1(\mathbb{R})$ for the equation (1) from the viewpoints of the solitons. We extend the global results for DNLS to the equation (1) by variational approach. Interestingly, if $b < 0$, 4π-mass condition in DNLS is improved due to the defocusing effect from the quintic term.

Summary: We consider the following nonlinear Schrödinger equation of derivative type:

$i\partial_t u + \partial_x^2 u + i|u|^2\partial_x u + b|u|^4 u = 0,\ (t,x) \in \mathbb{R}\times\mathbb{R},\ b \in \mathbb{R}.$

This equation has a two-parameter family of solitons. The value $b = -\frac{3}{16}$ gives the turning point where the structure of the solitons changes. Especially algebraic solitons exist only for the case $b > -\frac{3}{16}$. In previous results the orbital stability and instability of these solitons have been studied in the case $b \geq 0$. In this talk, by variational approach we prove the orbital stability of the solitons including the algebraic solitons in the case $-\frac{3}{16} < b < 0$. We see that the effect of the momentum plays an essential role in the arguments on the stability of the solitons.

Summary: In this talk, we consider the Cauchy problem of the system of quadratic derivative nonlinear Schrödinger equations. This system was introduced by M. Colin and T. Colin (2004) as a model of laser-plasma iteraction. Some well-posedness results in the Sobolev space $H^s(\mathbb{R}^d)$ was obtained in the previous works by H. Hirayama (2014) and H. Hirayama and S. Kinoshita (2019). We improve these results for conditional radial initial data by rewriting the system into radial form.

Summary: We study the scattering problem for a dissipative NLS with large initial data.

Summary: We consider mass-subcritical nonlinear Schrödinger equation. It is known that under the radial symmetry, the Cauchy problem is well-posed in the scale critical Sobolev space. In this talk, we consider long time behavior of solutions. In particular, we study a minimization problem with respect to non-scattering solutions.

Summary: We discuss the Riemann problem for the isentropic compressible Euler equations in two space dimensions with the pressure law describing the Chaplygin gas. It is well known that there are Riemann initial data for which the 1D Riemann problem does not have a classical BV solution, instead a δ-shock appears, which can be viewed as a generalized measure–valued solution with a concentration measure in the density component. We prove that in the case of two space dimensions there exists infinitely many bounded admissible weak solutions starting from the same initial data.

Summary: We consider the motion of a point mass in a 1D viscous compressible fluid. Our main theorem shows that the velocity of the fluid $u(x,t)$ decays time asymptotically as $||u(\cdot,t)||_{L^\infty} \approx t^{-1/2}$, while the velocity of the point mass $V(t)$ decays at least as $|V(t)| \approx t^{-3/2}$. This is in contrast with the result for the Burgers fluid (Vázquez and Zuazua, *Comm. Partial Differential Equations*, 28:1705–1738, 2003).
The result above is proven as a corollary of more detailed pointwise decay estimates of the fluid variables, which are shown by using the pointwise decay estimates of Green's function for the corresponding Cauchy problem (Liu and Zeng, *Mem. Amer. Math. Soc.*, 125(599), 1997). Our result shows that the Green's function approach is useful in the analysis of fluid-structure interaction problems.

Summary: Global existence of solutions to the compressible Navier–Stokes–Korteweg system around a constant state is studied. This system describes liquid-vapor two phase flow with phase transition as diffuse interface model. In previous works they assume that the pressure is a monotone function for change of density similarly to the usual compressible Navier–Stokes system. On the other hand, due to phase transition the pressure is accurately non-monotone function and the linearized system loses symmetry in a critical case such that the derivative of pressure is 0 at the given constant state. It is shown that in the critical case for small data whose momentum has derivative form there exist global L^2 solutions and the parabolic type decay rate of the solutions is obtained. The proof is based on decomposition method for solutions to a low frequency part and a high frequency part.

Summary: We consider the compressible and incompressible two-phase flows with phase transitions and surface tensions in bounded regions. We assume that the two fluids are separated by a sharp free boundary. We show the existence of the global unique strong solution supposing that the initial data are small in their natural norms.

Summary: We consider a diffuse interface model for the flow of two viscous incompressible Newtonian fluids with different densities in a bounded domain in two and three space dimensions and prove existence of weak solutions for it. In contrast to previous works, we study a model with a singular non-local free energy, which controls the fractional L^2-Sobolev norm of the volume fraction. We show existence of weak solutions for large times with the aid of an implicit time discretization.

68 Yoshihiro Shibata (Waseda Univ.) 2 phase problem for the Navier–Stokes equations in the whole space 10

Summary: In this talk, I will talk about the global well-posedness for the two phase problem of incompressible viscous fluid flows separated by a sharp interface in the whole space. I consider the case where the surface tension is taken into account. The key is to use the Hanzawa transform whose vertex is at the barycenter point of the unknown time dependent domain, maximal L_p-L_q regularity results and L_p-L_q decay properties of linearized equations. Since the domain is unbounded, we have to choose different exponents q_1 and q_2 in space.

69 Yoshihiro Shibata (Waseda Univ.) On the decay properties of Stokes semigroup associated with two phase problem with surface tension 10

Summary: In this talk, I will talk about the L_p-L_q decay properties of the Stokes semigroup which arises in the study of two phase problem for the viscous incompressible fluid flows separated by a sharp interface with surface tension in the whole space. This is a key step to prove the global well-posedness.

70 Tetu Makino (Yamaguchi Univ.*) * Juhi Jang (Univ. Southern California / KIAS) Spectral analysis of linearized non-radial oscillations of gaseous stars 10

Summary: The functional analytic property of the linearized operator in the equation of perturbations around spherically symmetric equilibria of gaseous stars governed by the Euler–Poisson equations has been studied. In spite of often used supposition, the spectrum of the self-adjoint realization is not of the Sturm–Liouville type generally, but its structure can be clarified with sufficient concreteness.

14:15–16:15

71 Ryo Kanamaru (Waseda Univ.) Improvement of the extension theorem of strong solutions to Navier–Stokes equations by Vishik type spaces 10

Summary: We show the Brezis–Gallouet–Wainger inequalities by means of the Vishik type spaces which can be wider than $\dot{B}^0_{\infty,\infty}$. As an application of those inequalities. We prove that the strong solutions to Navier–Stokes equations can be extended if the scaling invariant quantity of vorticity is bounded. Namely, the Beale–Kato–Majda type regularity criteria are improved in the terms of the Vishik type space.

72 Itsuko Hashimoto (Kansai Univ. / Osaka City Univ.) Asymptotic stability of radially symmetric stationary solutions for the multi-dimensional Burgers equation 10

Summary: Stability of the stationary solution of the Burgers equation in exterior domains in n-D is concerned. We consider the asymptotic stability of radially symmetric stationary solutions for multi-dimensional Burgers equation from the n-D perturbed fluid motion. For this purpose, we apply the result by Kozono and Ogawa which showed the asymptotic stability of stationary solutions for the incompressible Navier–Stokes equation on multi-dimensional spaces.

73 Huanyuan Li (Univ. of Tokyo) On local strong solutions to the Cauchy problem of two-dimensional nonhomogeneous incompressible Navier–Stokes–Korteweg equations .. 10

Summary: In this talk, we concern the Cauchy problem of the nonhomogeneous incompressible Navier–Stokes–Korteweg equations on the two-dimensional space with vacuum as the far field density. We establish the local existence and uniqueness of strong solutions to the 2D Cauchy problem of the nonhomogeneous incompressible Navier–Stokes–Korteweg equations provided the initial density decay not too slow at infinity. Our analysis is based on some weighted energy estimates.

Summary: In this talk, we consider a steady flow of an incompressible viscous fluid for a 3-D aperture domain. As is well known, J. G. Heywood[1] introduces an aperture domain. In the aperture domain he obtains a steady solution of the Navier–Stokes equations with the restricted flux condition. We define a generalized aperture domain. In such a domain, we consider the steady flow of an incompressible viscous fluid with the flux condition. We obtain a solution of such a problem with the restricted flux condition.

Summary: We consider the stationary Navier–Stokes equations in 2D. Under the assumption that $\nabla v \in L^q$ with some $q \in (2, \infty)$, we give asymptotic properties of solutions. As its application, we also show the Liouville-type theorem.

Summary: We study the temporal decay estimate of the Oseen semigroup in a two-dimensional exterior domain. We establish the local energy decay estimate with a suitable dependence on the small translation speed, which is a significant extension of Hishida's result in 2016. As an application, we prove the L^q-L^r estimates of the Oseen semigroup uniformly in the small translation speed.

Summary: We investigate the Navier–Stokes initial boundary value problem in the half-plane with non decaying initial data. We introduce a technique that allows to solve the two-dimesional problem, further, but not least, it can be also employed to obtain weak solutions, as regards the non decaying initial data, to the three-dimensional Navier–Stokes IBVP.

Summary: A model from electro-magneto-hydrodynamics describing a completely ionized gas, a plasma, is studied. Local well-posedness of the problem in time weighted L_p space is obtained by means of maximal regularity of the linearized problem, and the induced local semiflow in the proper state space is constructed. Based on the principle of linearized stability, it is shown that the trivial solution of the problem is exponentially stable.

16:30–17:30 Award Lecture for the 2018 MSJ Analysis Prize

Shuichi Kawashima (Waseda Univ.) Dissipative structure and stability analysis for symmetric hyperbolic systems

Summary: We review the general theory on the stability analysis for hyperbolic systems of balance laws. The theory assumes two structural conditions for the system: One is the existence of a mathematical entropy and the other is the stability condition (called Shizuta–Kawashima Condition). Under these structural conditions we can show the global existence and optimal decay of solutions for small initial data. This general theory is valid for systems with symmetric relaxation. Recently, however, we found several interesting examples which have non-symmetric relaxation and hence the general theory is not applicable. Among such examples, we mention the Timoshenko system and the Euler–Maxwell system. We report recent works for these examples and explain their weak dissipativity of the regularity-loss type.

Real Analysis

March 19th (Tue) Conference Room II

9:00–12:00

1 Yōhei Yamasaki ♭ A C^0 homeomorphism with infinite "volume" ····· 10

Summary: The author introduced the oriented and non-oriented volumes in the C^0 class in 2016, and revised the non-oriented volume in 2018. A "counter example" has been found to violate the property "the non-oriented volume exceeds the oriented volume", with respect to the former definition. This talk gives an example similar to the above "counter example". which becomes clear not to violate the above property, with respect to the latter definition. It suggests that the "counter example" turns an affirmative example.

2 Toshiharu Kawasaki (Nihon Univ. / Tamagawa Univ.) Indefinite integral and primitive function ····· 10

Summary: For a function $f : [a, b] \longrightarrow \mathbb{R}$ and a point $c \in [a, b])$, $F(x) = \int_c^x f(t)dt$ is called the indefinite integral of f and a function G satisfying $G' = f$ is called the primitive function of f.
As well-known, if the function f is continuous, then $F' = f$ holds everywhere (fundamental theorem of calculus). Therefore, ignoring the difference in constants, $G = F$ holds.
In this talk, we consider in the case where f is not necessarily continuous, moreover, G is not continuous.

3 Ryoichi Kunisada (Waseda Univ.) L^p spaces over finitely additive measures ····· 10

Summary: In this talk, we study L^p spaces over finitely additive measures. For a given finitely additive measure μ, we give a method of extending the space $L^p(\mu)$. The completeness of such an extended L^p space is also discussed.

4 Toshiaki Murofushi (Tokyo Tech)
Naoki Enomoto (Tokyo Tech) Relationships between properties of non-additive measures and properties of supremum increments: null-continuity and property (S) ····· 10

Summary: The supremum increment of a nonadditive measure μ on a σ-field $\mathscr{F}$ is the nonadditive measure ${}^{\Delta}\mu$ defined by ${}^{\Delta}\mu(A) = \sup\{\mu(A \cup B) - \mu(B) \mid B \in \mathscr{F},\ \mu(B) < \infty\}$ for $A \in \mathscr{F}$. If μ is null-additive, then the null-continuity of μ is equivalent to the null-continuity of ${}^{\Delta}\mu$. Generally, even if μ is null-continuous, ${}^{\Delta}\mu$ is not necessarily null-continuous; even if ${}^{\Delta}\mu$ is null-continuous, μ is not necessarily null-continuous. If μ is null-additive and has property (S), then ${}^{\Delta}\mu$ has property (S). If μ is uniformly autocontinuous, then μ has property (S) iff ${}^{\Delta}\mu$ has property (S). Generally, even if μ has property (S), ${}^{\Delta}\mu$ does not necessarily have property (S); even if ${}^{\Delta}\mu$ has property (S), μ does not necessarily have property (S).

5 Ryoji Fukuda (Oita Univ.)
Aoi Honda (Kyushu Inst. of Tech.)
Yoshiaki Okazaki (Fuzzy Logic Systems Inst.) Non-linear integral for an expansion of non-additive measure ····· 10

Summary: Let $([0, +\infty], \oplus, \otimes)$ be the generalized ring. Let $(X, \mathcal{B})$ be a measurable space and $\mu : \mathcal{B} \to [0, \infty]$ be a set function satisfying $\mu(\emptyset) = 0$ (the non-additive measure). An extension $E(f; \mu) : \mathcal{F} \to [0, \infty]$ of μ is a mapping $E(f; \mu) : \mathcal{F} \to [0, \infty]$ such that $E(\chi_A; \mu) = \mu(A),\ A \in \mathcal{B}$, where χ_A is the characteristic function, $\mathcal{F}$ is the set of all $[0, e]$ valued measurable functions and e is the left unit for $\otimes(e \otimes e = a)$. We shall define two extensions of μ. Those are considered as the non-linear integrals of $f \in \mathcal{F}$ with respect to μ.

Summary: To investigate the geometry of normed space, geometric constants play important roles. Among them the James constant has been studied by a lot of mathematicians. We also treat the generalized notions of orthogonality in normed space. The generalized orthogonality in normed space have been studied in many papers. The usual orthogonality in inner product space is symmetric. By the definition Isosceles orthogonality is symmetric, too. However, Birkhoff orthogonality is not symmetric in general. The two-dimensional space in which Birkhoff orthogonality is symmetric is called Radon plane. We consider the value of James constant in such planes.

Summary: We study the asymptotic behavior of two iterative sequences for approximating minimizers of convex functions in complete geodesic metric spaces with curvature bounded above.

Summary: Let H be a real Hilbert space, let $z \in H$ and let $f, g : H \to (-\infty, \infty]$ be proper, lower semicontinuous and convex functions such that $\mathrm{dom} f \cap \mathrm{dom} g \neq \emptyset$. We consider convergence rate of operator splitting methods for solving the following minimization problem:

$$\text{minimize } \frac{1}{2}\|x - z\|^2 + f(x) + g(x).$$

Summary: In this talk, we consider the best approximation problem in a Banach space and deal with some strong convergence theorems for the problem.

Summary: In this talk, we study attractive points of normally 2-generalized hybrid mappings and prove weak convergence theorems for the mappings. We study a broad class of sequences which covers nonexpansive sequences, generalized hybrid sequences, 2-generalized hybrid sequences. Then, we prove nonlinear ergodic theorems for such sequence. We also prove weak and strong convergence theorems for the sequences. Further, we study fixed points theorems for some nonlinear mappings.

Summary: Birkhoff(–James) orthogonality is one of the most important generalized orthogonality relation in Banach spaces. It is not globally symmetric in the most Banach spaces, but can be locally symmetric in some senses. In this talk, we clarify left (or right) symmetric points for Birkhoff orthogonality in von Neumann algebras.

Summary: The notion of strong Birkhoff orthogonality is defined on Hilbert C^*-modules by using Birkhoff orthogonality and scalar products. We consider it in the setting of von Neumann algebras, and study its local symmetry. As an application, it is shown that if two von Neumann algebras have the same linear structure and strong Birkhoff orthogonality then they are $*$-isomorphic to each other.

Summary: It is thought that some distance space which are not linear spaces have properties such that the generalization of properties in linear spaces. However, it remains to be elucidated what geometrical properties exist in the spaces. Here we report that the spaces have some geometrical properties given by triangles of three points and convex combinations.

Summary: In 1978 Uchiyama gave a proof of the characterization of CMO which is the closure of $C^\infty_{\rm comp}$ in BMO. We extend the characterization to the closure of $C^\infty_{\rm comp}$ in the Campanato space with variable growth condition. As an application we characterize compact commutators $[b,T]$ and $[b,I_\alpha]$ on Morrey spaces with variable growth condition, where T is the Calderón–Zygmund singular integral operator, I_α is the fractional integral operator and b is a function in the Campanato space with variable growth condition.

Summary: For a Young function Φ and $\varphi\in\mathcal{G}^{\rm dec}$, let $L^{(\Phi,\varphi)}(\mathbb{R}^n)=\left\{f\in L^1_{\rm loc}(\mathbb{R}^n):\|f\|_{L^{(\Phi,\varphi)}}<\infty\right\}$, $\|f\|_{L^{(\Phi,\varphi)}}=\sup_B\|f\|_{\Phi,\varphi,B}$. Then $\|\cdot\|_{L^{(\Phi,\varphi)}}$ is a norm and $L^{(\Phi,\varphi)}(\mathbb{R}^n)$ is a Banach space, since $\|f\|_{\Phi,\varphi,B}=\|f\|_{L^\Phi(B,dx/(|B|\varphi(r)))}$, which is a norm on the Orlicz space $L^\Phi(B,dx/(|B|\varphi(r)))$.
If $\Phi(r)=r^p$ $(1\le p<\infty)$, then we denote $L^{(\Phi,\varphi)}(\mathbb{R}^n)$ by $L^{(p,\varphi)}(\mathbb{R}^n)$ which is the generalized Morrey space. We give a necessary and sufficient condition for the boundedness of M_ρ from $L^{(\Phi,\varphi)}(\mathbb{R}^n)$ to $L^{(\Psi,\varphi)}(\mathbb{R}^n)$.

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

14:15–15:15 Award Lecture for the 2018 MSJ Analysis Prize

Summary: A survey of some recent results for the estimates of multilinear pseudo-differential operators in Lebesgue, Hardy, and BMO spaces will be given.

15:30–16:50

Summary: The Kantrovitch operator is used to approximate functions. In particular, it is well known that this operator can be used to show the density of polynomials in $C[0,1]$. Here we compare the Kantrovitch operator with the Hardy–Littlewood maximal operator. What is important here is the constant can be taken 1, which is optimal. This is a joint work with Burenkov in Moscow and Ghorbanalizadeh in Iran.

Summary: We will disprove that the Morrey space $\mathcal{M}^p_{q_0}$, which is a subspace of $\mathcal{M}^p_{q_1}$, is dense in $\mathcal{M}^p_{q_1}$ when $1\le q_1<q_0\le p<\infty$. The proof is based on a combinatoric observation done earlier by myself, Sugano and Tanaka.

19 Yoshihiro Sawano (Tokyo Metro. Univ.) ♭ Elliptic differential operators with non-smooth coefficients in uniformly local L^2 spaces ····· 10

Summary: The aim of this talk is to propose to use uniformly locally square integrable function spaces to deal with the elliptic differential operators with non-smooth coefficients. We do not assume any other regularity condition. Although the singular integral operators fail to be bounded, we can handle the operators to some extent. This is a joint work with Mastylo in Poland.

20 Toru Nogayama (Tokyo Metro. Univ.) Boundedness of the commutators of fractional integral operators on mixed Morrey spaces ····· 10

Summary: Mixed Morrey spaces are one of the extension of classical Morrey spaces and the generalization of some function spaces. In this talk, we give a necessary and sufficient condition for the boundedness of the commutators of fractional integral operators on mixed Morrey spaces.

21 Takeshi Iida (Fukushima Nat. Coll. of Tech.) Note on the integral operators in weighted Morrey spaces ····· 10

Summary: In this talk, we consider the boundedness of the linear and multilinear fractional maximal operator and the fractional integral operator within the framework of weighted Morrey spaces. By the observation of the endpoint cases, we obtain the results. The results recover the inequalities which is due to I. Sato, Sawano and Tanaka and the inequalities which is due to Sawano, Sugano and Tanaka.

22 Hiro-o Kita (Kagoshima Univ.*) * On generalized weak Orlicz spaces constructed by φ-functions ····· 10
Takashi Miyamoto (Osaka Kyoiku Univ.)
Naoko Ogata (Kobe Univ.)

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

23 Shigehiko Kuratsubo (Hirosaki Univ.*) Multiple Fourier series and lattice point problems ····· 10
Eiichi Nakai (Ibaraki Univ.)

Summary: We consider the relation between multiple Fourier series and lattice point problems

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

Takeshi Kawazoe (Keio Univ.) Singular integrals for Jacobi analysis

Summary: In this talk I briefly overview the history of harmonic analysis on semisimple Lie groups, especially the case of real rank one, and the Jacobi hypergroup $(\mathbf{R}_+, \Delta, *)$. Then I introduce recent topics of singular integrals on the Jacobi hypergroup. We would like to generalize the Calderón-Zygmund theory for the Jacobi hypergroup. Actually, we shall obtain a CZ class on $\mathbf{R}_+$ such that, if a function g belongs to the CZ class, the convolution operator $g*$ is bounded from $L^p(\Delta)$ to itself for $1 < p \leq 2$. However, we have some obstacles. The case of $SU(1,1)$ is excluded and a restriction on p is required.

March 20th (Wed) Conference Room II

9:00–11:50

24 Masaaki Mizukami (Tokyo Univ. of Sci.) Existence of global weak solutions in a chemotaxis-Navier–Stokes system I: Effect of strong diffusion ····· 10

Summary: This talk considers a chemotaxis-Navier–Stokes system with nonlinear diffusion. In 2015 Zhang–Li showed existence of global weak solutions under some condition; however, the proofs of this result contained several essential gaps. Therefore the purpose of the present talk is to give existence of global weak solutions by correcting arguments in the previous result. The main result in this talk asserts that "strong" diffusion derives existence of global weak solutions.

Summary: This talk considers a chemotaxis-Navier–Stokes system with logistic-type damping. In the case that the logistic-type damping is given by $+\kappa n - \mu n^2$, a previous paper (Kurima–M.) obtained existence of global weak solutions under some conditions. However, the case that the logistic-type damping is given by $+\kappa n - \mu n^\alpha$ with some $\alpha > 1$ seems not to be studied. Therefore the purpose of the present talk is to obtain existence of global weak solutions in the case that the logistic-type damping is given by $+\kappa n - \mu n^\alpha$ with some $\alpha > 1$. The main result in this talk asserts that "strong" logistic-type damping derives existence of global weak solutions.

Summary: We consider the asymptotic limits of the viscous Cahn–Hilliard equation. In 2014, Bui, et al. proved the existence of the solutions of the Cahn–Hilliard equation and the Allen–Cahn equation by considering the asymptotic limits of the viscous Cahn–Hilliard equation under the Sobolev subcritical growth condition on the nonlinear term. In this talk, we exclude this growth condition by decomposing the nonlinear function into the sum of a monotone function and a locally Lipschitz perturbation, and show the existence of the solutions of the Cahn–Hilliard equation and the Allen–Cahn equation and with some improved regularity.

Summary: We are concerned with the comparison theorem of the initial-boundary value problem for nonlinear parabolic equations governed by the nonlinear boundary conditions. It is well known that classical comparison principle is a useful tool in the study of reaction diffusion equations. This classical result claims that if two initial data satisfy some order then the corresponding solutions keep the initial data order. In this talk, we clarify the relationship of two solutions of reaction diffusion equations governed by the different nonlinear boundary conditions.

Summary: We consider the following complex Ginzburg–Landau equation (CGL) with linear term.

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

where $\theta \in (-\pi/2, \pi/2)$; i denotes the imaginary unit; $\gamma \in \mathbb{R}$; $\Omega \subset \mathbb{R}^N$ is a bounded domain; $T > 0$. In this talk we investigate an asymptotic behavior of solutions of (CGL), especially finite time blow-up. It was shown by Cazenave et al, that finite time blow-up could occur for initial data which are negative in a certain energy. We would like to talk about the finite time blow-up for initial data with positive energy. In the proof, we apply the potential-well method.

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

30 Makoto Okumura (Osaka Univ.) A structure-preserving scheme for the Allen–Cahn equation with dynamic boundary conditions ····· 10

Summary: We propose a structure-preserving scheme for the Allen–Cahn equation with dynamic boundary conditions using the discrete variational derivative method (DVDM). In DVDM, how to discretize the energy which characterizes the equation, it is essential. Modifying the conventional manner and using another summation-by-parts formula, we can use the central difference operator as an approximation of a space derivative on the discrete boundary condition. In this talk, we mainly show the existence and uniqueness of the solution for the proposed scheme and the error estimate.

31 Ryota Nakayashiki (Chiba Univ.) Coupling system of Allen–Cahn equation and phase-field model of grain boundary motion governed by dynamic boundary condition ····· 10

Summary: In this talk, we consider a coupling system, consisting of Allen–Cahn type equation, and a PDE model of grain boundary motion, under the dynamic boundary condition. The motivation of this study is to develop the mathematical theories to deal with the more dynamical physical situations and to apply temperature optimal control problems for grain boundary motion. On this basis, we set the goal of this talk is to address the issues, concerned with the qualitative results of the system, such as the existence of solutions to the system, and the continuous dependence of the system, and so on.

32 Kota Kumazaki (Nagasaki Univ.) On a multiscale model describing moisture transport in concrete materials ····· 10

Summary: In this talk, we consider a new two-scale problem which is given as mathematical model for moisture transport in concrete materials. Our model consists of the diffusion equation for the relative humidity in the entire of concrete (macro domain) and the free boundary problems describing the relationship between the relative humidity and the degree of saturation in infinitely pores (micro domain). In our model, the structures of the micro domains are unknown, and this is a significant feature of our model to emphasize. In this talk, we discuss the existence and uniqueness of a solution to our model.

33 Takeshi Fukao (Kyoto Univ. of Edu.)
Hao Wu (Fudan Univ.) Long time behavior of GMS model with a strict separation property from pure phases ····· 10

Summary: In this talk, we discuss the long time behavior of Cahn–Hilliard system with dynamic boundary condition of GMS type. In this model, a characteristic property of conservation holds which is related to the sum of the volume in the bulk and on the boundary. By virtue of the effective usage of this property, the well posedness is discussed. Moreover, by applying the energy estimate the characterization of the omega limit set is obtained.

34 Yutaka Tsuzuki (Hiroshima Shudo Univ.) Solvability of problems for Vlasov–Poisson equations with angle error in magnetic field in a half-space ····· 10

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

35 Yoshimasa Sasaki (Niigata Univ.)
Hiroki Ohwa (Niigata Univ.) Continuous dependence on the initial conditions and flux functions of solutions for a single conservation law ····· 10

Summary: We prove a continuous dependence on the initial conditions and flux functions of solutions for a single conservation law. We can derive from the result that approximate solutions constructed by the wave-front tracking methods are Cauchy sequence. The proofs rely on the well-posedness theory introduced by Liu and Yang.

36 Makoto Nakamura (Yamagata Univ.)
Yuya Sato (Yamagata Univ.)
Global solutions for a semilinear diffusion equation in expanding or contracting spaces 10

Summary: The Cauchy problem for the semilinear diffusion equation is considered in the de Sitter spacetime with the spatial zero-curvature. Global solutions and their asymptotic behaviors for small initial data are shown for positive and negative Hubble constants. The effects of the spatial expansion and contraction are studied on the problem.

37 Makoto Nakamura (Yamagata Univ.)
On the Navier–Stokes equations in homogeneous and isotropic spacetimes with a constant density of mass 10

Summary: The Navier–Stokes equations are considered in homogeneous and isotropic spacetimes. The Cauchy problem for the Navier–Stokes equations is considered under the constant density.

38 Takayoshi Ogawa (Tohoku Univ.)$^{\flat}$
Senjo Shimizu (Kyoto Univ.)
Maximal regularity for the Cauchy problem of heat equations in BMO 10

Summary: We show maximal regularity for the Cauchy problem of the heat equation in the class of bounded mean oscillation (BMO). It is known that the large class of the parabolic equation has maximal regularity in the UMD Banach space X. If the power is not the end-point case, the necessary and sufficient condition on maximal regularity is so called R-boundedness. Since UMD Banach space is necessarily reflexive, non-reflexive Banach space such as BMO is not the subject to the general theory. We show maximal regularity and sharp trace estimate of the solution of heat equations.

14:15–15:05

39 Akio Ito
Fix-Caginalp phase field model with quasi-variational structure on the boundary condition 10

Summary: We consider an initial-boundary value problem of a phase field model of Fix-Caginalp type whose boundary condition for the relative temperature has a quasi-variational structure. This structure gives one for inner products of the suitable real Hilbert space. So, we can apply the theory of evolution inclusions on a real Hilbert space which has a quasi-variational structure for inner products which was established in the paper, Evolution inclusion on a real Hilbert space with quasi-variational structure for inner products, JOCA 1981. Actually, applying the results obtained in the above paper, we can show that this initial-boundary value problem has at least one solution in the quasi-variational sense.

40 Noriaki Yamazaki (Kanagawa Univ.)
Nobuyuki Kenmochi (Chiba Univ.*)
Ken Shirakawa (Chiba Univ.)
Singular optimal control problems for nonlinear evolution equations governed by double time-dependent subdifferentials 10

Summary: We consider doubly nonlinear evolution equations governed by double time-dependent subdifferentials in uniformly convex Banach spaces. Note that our equations has multiple solutions, in general, and therefore the optimal control problem associated with our state equation is singular. Thus, in this talk, we investigate the singular optimal control problem formulated for our non-well-posed state systems.

41 Ken Shirakawa (Chiba Univ.)
Hiroshi Watanabe (Oita Univ.)
Structural observations for one-dimensional phase-field system associated with grain boundary motion 10

Summary: In this talk, we consider a one-dimensional version of "Kobayashi–Warren–Carter type system", which is based on a phase-field model of grain boundary motion, proposed in [Kobayashi–Warren–Carter, Phys. D, 140 (2000), 141–150]. The interest of this talk is in the concrete behavior of special kinds of solutions, which reproduce the typical structures, with *facets*, observed in polycrystalline bodies. On this basis, we define a new class of solutions, named *crystalline solutions*. Under suitable assumptions, the sufficient conditions for the existence and uniqueness of crystalline solutions, and conditions for non-degeneracy of mobilities, will be shown as the Main Theorems of this talk.

42 Miyu Hotta (Japan Women's Univ.)
Toyohiko Aiki (Japan Women's Univ.)
On growth model having age-structure for jellyfish with food chain ··· 10

Summary: The life cycle of jellyfish is so complicated that we simplify it as follows: Jellyfishes lay eggs. The eggs become polyp or ephyra. Polyps live on tetrapod, increase with asexual reproduction which has three kinds of growth process. Moreover, ephyra becomes a jellyfish after growing up. Here, we assume that the region is a one-dimensional interval (0,1) and that there is tetrapod at $x = 1$ and propose a system of diffusion equations with dynamic boundary condition having age structure. In this talk we show the modeling process, and existence and uniqueness of a solution to the model.

43 Miu Takahashi (Japan Women's Univ.)
Toyohiko Aiki (Japan Women's Univ.)
Martijn Anthonissen
(Eindhoven Univ. of Tech.)
Existence of a solution of the initial boundary value problem describing a real experiment related to the Soret effect ····· 10

Summary: The Soret effect is a substance flow due to the force of temperature gradient in mixed solution. There are several studies on molecular transport utilizing this phenomenon, and as one of the research methods, there is an experiment in which heat sources(metal) are periodically arranged. In the present study we consider the experiment related to the Soret effect from the standpoint of mathematical model. Here, we will show existence of a weak solution of the model.

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

Yoshikazu Giga (Univ. of Tokyo) On total variation flow type equations

Summary: The classical total variation flow is the L^2 gradient flow of the total variation. The variation of a function is a singular energy at the place where the slope of the function equals zero. Because of this structure, its gradient flow is actually nonlocal in the sense that the speed of slope zero part (called a facet) is not determined by infinitesimal quantity. Thus, the definition of a solution itself is a nontrivial issue even for the classical total variation flow.

Recently, there need to study various types of such equations. A list of examples includes the total variation map flow as well as the classical total variation flow and its fourth order version in image denoising, crystalline mean curvature flow or fourth order total variation flow of exponential type in crystal growth problems which are special important problems in materials science.

In this talk, we survey recent progress on these equations with special emphasis on finite extinction property and a crystalline mean curvature flow whose solvability was left open more than ten years. We shall give a global-in-time unique solvability in the level-set sense.

Functional Analysis

March 17th (Sun) Conference Room IX

10:30–12:00

1 Hiroshi Inoue (Daiichi Univ. of Pharm.) Non self-adjoint Hamiltonian and physical operators constructed by biorthogonal sequences in Hilbert space ····· 15

Summary: The notions of generalized Riesz systems and $\mathcal{D}$-quasi bases play an important rule for constructions physical operators. In this talk we introduce some results about the relationships between generalized Riesz systems and $\mathcal{D}$-quasi bases.

2 Atia Afroz (Saitama Univ.) Bifurcation and hysteresis sets of Euler buckling problem ····· 10

Summary: We discuss the modified version of Euler Buckling problem as minimizing the problem by variational formulation. We discuss the smoothness of the problem and derive the equations of bifurcation set B and hysteresis set H up to order 3. From several numerical results, we draw approximations of B and H under suitable set-up and observe the change of B and H. We observe that bifurcation set B and hysteresis set H have the same tangent at the origin and when length l is bigger then the narrow regions between bifurcation set and hysteresis set is also increasing.

3 Takeo Kamizawa (Tokyo Univ. of Sci.) How can we compute the solutions to master equations of open quantum systems? I ····· 10

Summary: The dynamics of a quantum system is described by a certain type of differential equations on the set of states, and the solution is often assumed to be completely positive and trace-preserving. According to Choi, a completely positive operator has a particular representation so-called the Kraus representation. In this presentation, we will review some procedure to compute this type of representation for the solution of the differential equation. The point of this procedure is that it does not depend on the computations of eigenvalues and eigenvectors, which can be difficult if the dimension is high.

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

Summary: We show that the transition from a normal conducting state to a superconducting state is a second-order phase transition in the BCS-Bogoliubov model of superconductivity from the viewpoint of operator theory. Here we have no magnetic field. Moreover we obtain the exact and explicit expression for the gap in the specific heat at constant volume at the transition temperature. To this end, we have to differentiate the thermodynamic potential with respect to the temperature two times. Since there is the solution to the BCS-Bogoliubov gap equation in the form of the thermodynamic potential, we have to differentiate the solution with respect to the temperature two times. Therefore, we need to show that the solution to the BCS-Bogoliubov gap equation is differentiable with respect to the temperature two times as well as its existence and uniqueness. We carry out its proof on the basis of fixed point theorems.

5 Kiyoomi Kataoka (Univ. of Tokyo*) On asymptotic analysis of the evolution operator related to the continuous Kuramoto equation ····· 15

Summary: Kuramoto's famous conjecture is that there is a positive constant K_c such that the system of oscillators becomes synchronized only when the coupling constant $K > K_c$. H. Chiba proved this conjecture for the continuous version of Kuramoto model in 2015. His proof covers the cases that the initial distributions $g(\omega)$ of frequencies of oscillators are Gaussian or Cauchy. His key tool is the precise analysis of the generalized eigenvalues of some unbounded linear operator T related to $g(\omega)$ on some Hilbert space. This year, we get an asymptotic expansion of $(e^{tT}\varphi, \psi)_g$ as $t \to \infty$ directly for some much wider class of analytic distributions $g(\omega)$. As a dirct application, we extend Chiba's exponential decay result of synchronization parameter $|\eta(t)|$ to such $g(\omega)$.

14:15–16:00

6 Keiji Nakatsugawa (Hokkaido Univ.)
Toshiyuki Fujii (Asahikawa Med. Univ.)
Avadh Saxena (Los Alamos Lab.)
Satoshi Tanda (Hokkaido Univ.)
Time operators and time crystals ····· 10

Summary: How to define self-adjoint time operators is an important open problem. In this talk we use a generalized commutation relation called the generalized weak Weyl relation (GWWR) to derive self-adjoint time operators for a free particle confined on a ring. Let $\hat{\pi}_\theta$ be an angular momentum operator, $\hat{H} = \hat{\pi}_\theta^2/2I$ be a Hamiltonian operator and $\hat{f}$ be a "periodic position operator". We show that if $\hat{\pi}_\theta$ and $\hat{f}$ satisfy $[\hat{\pi}_\theta, \hat{f}] = -i\hbar\hat{\mathscr{C}}$, then there exists a self-adjoint time operator which satisfies $[\hat{H}, \hat{T}] = i\hbar\hat{\mathscr{C}}$: These commutation relations are direct consequences of the GWWR and $\hat{T}$ satisfies the GWWR. How to choose $\hat{f}$ depends on the system of interest. We consider two specific examples, namely a time-of-arrival operator and the recently proposed quantum systems called "time crystal". We surmise that time crystals are promising systems to define time operators.

7 Akito Suzuki (Shinshu Univ.)[♭]
Supersymmetry of chiral symmetric unitary operators ····· 15

Summary: We consider a supersymmetric aspect of unitary operators with chiral symmetry and define an index for such a unitary operator when it has a Fredholm property. We give a criterion for the Fredholm property and an index formula in terms of a discriminant operator and birth eigenspaces.

8 Fumio Hiroshima (Kyushu Univ.)
Existence, absence and localization of the ground state of the renormalized Nelson Hamiltonian ····· 15

Summary: The existence, uniqueness, and strict positivity of ground states of the possibly massless renormalized Nelson operator under an infrared regularity condition and for Kato decomposable electrostatic potentials fulfilling a binding condition are proven. If the infrared singularity condition is imposed, then the absence of ground states is shown. Exponential and superexponential estimates on the pointwise spatial decay and the decay with respect to the boson number for elements of spectral subspaces below localization thresholds are provided. Byproducts of our analysis are a hypercontractivity bound for the semi-group and a new remark on Nelson's operator theoretic renormalization procedure. We construct path measures associated with ground states of the renormalized Nelson operator whose analysis entails improved boson number decay estimates for ground state eigenvectors.

9 Koki Hirota (Ritsumeikan Univ.)
Purely imaginary eigenvalues of the semiclassical Zakharov–Shabat operator ····· 15

Summary: We study the eigenvalues of the Zakharov–Shabat operator corresponding to the focusing nonlinear Schrödinger equation in the inverse scattering method. Although this operator is non-self-adjoint, all eigenvalues become purely imaginary when the potential is single-robe. We give an alternative approach to this fact by using the exact WKB method in the semiclassical limit. Moreover, we show that there are no purely imaginary eigenvalues when the potential is odd function and its square is double-robe.

10 Yukihide Tadano (Univ. of Tokyo)
Kouichi Taira (Univ. of Tokyo)
Uniform bounds for discrete Birman–Schwinger operators ····· 15

Summary: We discuss uniform bounds of the Birman–Schwinger operators in the discrete setting. For uniformly decaying potentials, we obtain the same bound as in the continuous setting. However, for non-uniformly decaying potential, our results are weaker than in the continuous setting. As an application, we obtain unitary equivalence between the discrete Laplacian and the weakly coupled systems.

11 Yukihide Tadano (Univ. of Tokyo) Construction of Isozaki–Kitada modifiers for discrete Schrödinger operators with long-range perturbations on general lattices 15

Summary: Long-range scattering theory for discrete Schrödinger operators has been studied and it is known that Isozaki–Kitada modifiers, one of the modified wave operators, can be constructed for some kinds of lattices and that they give one-to-one correspondence between each scattering state of the unperturbed and perturbed operators. In this talk, We extend the above result to discrete Schrödinger operators on general lattices. In the proof, Isozaki–Kitada modifiers is given by the local construction of solution of the corresponding eikonal equations.

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

Hisashi Morioka (Doshisha Univ.) Weyl-type lower bound for non-scattering energies of time-harmonic acoustic equations

Summary: In this talk, we derive a Weyl-type lower bound for non-scattering energies (NSEs) of time-harmonic acoustic equations. A NSE is equivalent to the eigenvalue 1 of the S-matrix associated with the acoustic equation. Thus there exists an eigenspace of the S-matrix. If an energy is a NSE, there exists an incident wave such that its scattered wave vanishes. As far as the author knows, results on the existence of NSEs are scarce. Essentially, there are two cases. First one is the existence of infinitely many NSEs, when the inhomogeneity is compactly supported and spherically symmetric. On the other hand, if the inhomogeneity has suitable corners, it is known that the set of NSEs is empty.
In this talk, we consider a case where inhomogeneities exist in a bounded domain with smooth boundary. We assume that the index of refraction has a suitable discontinuity on the boundary. Then we show that there exists infinitely many NSEs with possible accumulation points are zero and infinity. Moreover, the number of NSEs satisfies a Weyl-type asymptotic lower bound at infinity. Our result is an application of the same type estimate for interior transmission eigenvalues. For the proof, we study the Dirichlet-to-Neumann (D-N) map. It is well-known that the S-matrix and the D-N map is equivalent. Then our problem can be reduced to the interior transmission eigenvalue problem.

March 18th (Mon) Conference Room IX

9:00–12:00

12 Yoritaka Iwata (Tokyo Tech)[b] Abstract formulation of the Cole–Hopf transform 15

Summary: Operator representation of Cole–Hopf transform is obtained based on the logarithmic representation of infinitesimal generators. For this purpose the relativistic formulation of abstract evolution equation is introduced. Even independent of the spatial dimension, the Cole–Hopf transform is generalized to a transform between linear and nonlinear equations defined in Banach spaces. In conclusion a role of transform between the evolution operator and its infinitesimal generator is understood in the context of generating nonlinear semigroup.
[Ref] Y. Iwata, Methods Func. Anal. Topology, accepted; arXiv:1804.01338.

13 Hideyasu Yamashita (Aichi Gakuin Univ.) Glauber–Sudarshan-type quantizations and their path integral representations for compact Lie groups 15

Summary: We consider an arbitrary irreducible unitary representation (π_λ, V_λ) of a compact semisimple Lie group, and apply the idea of Daubechies–Klauder (1985) and Yamashita (2011) on rigorous coherent-state path integrals to this representation. Our main theorem is two-fold: the first main theorem is in terms of Brownian motions and stochastic integrals, and proven using the Feynman–Kac–Itô formula on a vector bundle of a Riemannian manifold, due to Güneysu (2010). In the second main theorem, we consider a sequence (μ_n) of finite measures on the space of smooth paths, and a 'path integral' is defined to be a limit of the integrals with respect to (μ_n). The formulation and the proof of the second main theorem employ *rough path theory* originated by Lyons (1998).

Summary: In the study of the Riemann zeta function, the functional equation plays a fundamental role, and it is well known that many kinds of zeta functions satisfy functional equations. M. Sato found that there is a big group action behind such functional equations, and reached the notion of prehomogeneous vector spaces. In this talk, we deal with zeta functions in several variables of solvable prehomogeneous vector spaces associated with homogeneous cones, and give an explicit formula of their functional equations.

Summary: Let D_n be the n-dimensional Hermitian symmetric space of rank 2, realized as a bounded symmetric domain in $\mathbb{C}^n$, and we consider a polynomial on a subspace $\mathbb{C}^{n''}$. Then the speaker presents the result that the weighted Bergman inner product on D_n of an exponential function on $\mathbb{C}^n$ and a polynomial on $\mathbb{C}^{n''}$ is represented by using a hypergeometric polynomial. As an application, the speaker presents a result on construction of differential symmetry breaking operators from representations of $SO_0(2,n)$ to those of $SO_0(2,n') \times SO(n'')$.

Summary: We give an explicit formula for the Harish-Chandra c-function for a small K-type on a noncompact real split Lie group of type G_2. As an application we give an explicit formula for spherical inversion for a small K-type.

Summary: We give a higher order analogue of the Pfaffian version of the Cayley–Hamilton theorem. Using this theorem, we describe the vector space $(\mathcal{P}(\Lambda_2(V)) \otimes \Lambda_2(V)^{\otimes r})^{Sp(V)}$. This result is similar to the description of the algebra $(\mathcal{P}(V \otimes V^*) \otimes (V \otimes V^*)^{\otimes r})^{GL(V)}$ using the Cayley–Hamilton theorem of higher order (the result reported at the last MSJ meeting).

Summary: Let G be a real reductive Lie group and $\mathcal{D}$ an intertwining differential operator for G. Since $\mathcal{D}$ respects the action of G, the space $\mathcal{S}ol(\mathcal{D})$ of solutions to $\mathcal{D}$ is naturally a representation space of G. In fact it is known that "smallest" infinite-dimensional representations, so-called *minimal representations*, are realized on such spaces. In this talk, with the motivation above, we discuss the space $\mathcal{S}ol(\mathcal{D})_K$ of K-finite solutions to $\mathcal{D}$. More prcisely, we first give a Peter–Weyl type decomposition theorem for $\mathcal{S}ol(\mathcal{D})_K$. We then apply the decomposition theorem for the case $G = \widetilde{SL}(3,\mathbb{R})$ to realize on $\mathcal{S}ol(\mathcal{D})$ all irreducible unitary representations that are attached to the minimal nilpotent orbit.

Summary: We are concerned with holomorphically induced representations ρ of exponential solvable Lie groups G. Decomposing ρ into a direct integral of irreducible representations of G, we discuss some reciprocity in distribution sense and give concrete examples.

20 Toshihiko Matsuki (Ryukoku Univ.) Orthogonal multiple flag varieties of finite type: Even-degree case (Setting of problem) 15

Summary: Let G be the split orthogonal group of degree $2n$ over an arbitrary infinite field $\mathbb{F}$ of characteristic not 2. In this talk, we introduce multiple flag varieties $G/P_1 \times \cdots \times G/P_k$ of finite type. Here a multiple flag variety is said to be of finite type if it has a finite number of G-orbits with respect to the diagonal action of G.

21 Toshihiko Matsuki (Ryukoku Univ.) Orthogonal multiple flag varieties of finite type: Even-degree case (Classification) 15

Summary: Let G be the split orthogonal group of degree $2n$ over an arbitrary infinite field $\mathbb{F}$ of characteristic not 2. In this talk, we classify multiple flag varieties $G/P_1 \times \cdots \times G/P_k$ of finite type. Here a multiple flag variety is said to be of finite type if it has a finite number of G-orbits with respect to the diagonal action of G.

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

Masatoshi Kitagawa (Nara Women's Univ.) Invariant differential operators and uniformly bounded multiplicities

Summary: A unitary representation of a real reductive Lie group has unique irreducible decomposition. If the essential supremum of the multiplicities is finite, the representation is said to have uniformly bounded multiplicities. In this talk, we give several criteria for the uniform boundedness of multiplicities in the following three cases: restrictions of representations (branching laws); induced representations (harmonic analysis); and restrictions of parabolically induced representations. The criteria follow from a key result about an action of an algebra of invariant differential operators. We establish a relation between the essential supremum of multiplicities and an invariant of the algebra.

March 19th (Tue) Conference Room IX

9:00–12:00

22 Hiroko Manaka (Nihon Univ.) Results with respect to fixed point theorems of an elastic nonlinear mapping in Banach spaces 15

Summary: We treat with a bifunction V(x,y) defined for any x,y in a smooth Banach space E, which gives a generalized projection in E, and we give a definition of a V-strongly non-expansive mapping T on E that is characterized by this bifunction V. The mapping T has a property that the class of this mapping T includes the class of firmly non-expansive mappings, and it is non-expansive in a Hilbert space. However, we could show that there exists a Banach space where the mapping T is not non-expansive mapping. This mapping T is elastic according to types of Banach spaces. In this talk, we shall introduce results with respect to fixed point theorems of this mapping T, which are some convergence theorems and existence theorems for fixed points of this mapping T.

23 Kazuhiro Kawamura (Univ. of Tsukuba)
Hironao Koshimizu (Yonago Nat. Coll. of Tech.)
Takeshi Miura (Niigata Univ.) Isometries on $C^1([0,1])$ with respect to several norms 15

Summary: We introduce a framework of norms on $C^1([0,1])$, and give the characterization of surjective isometries on it.

Summary: We introduce a notion of generalized bi-circular idempotents on normed spaces. Then we characterize generalized bi-circular idempotents on $C^1([0,1])$ with respect to several norms.

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

Summary: We study 2-local surjective isometeries on certain spaces of complex-valued continuous functions. We do not assume linearity for the isometries. We mainly consider the Banach algebra of continuously differentiable functions on the closed unit interval with the sum norm.

Summary: We present Cauchy–Bunyakovsky–Schwarz type inequalities related to the Möbius operations, which are extensions of what was obtained early in 2018.

Summary: We consider a monotone map on von Neumann algebras with trivial center (factors). At first we characterize continuous functional calculus on factor. Using this fact, we can show that monotone maps on factor with some property are given by a operator monotone function.

Summary: In this talk, we present some reverses of the Golden–Thompson type inequalities with Specht's ratio and Olson order. The same inequalities are also provided with other constants. The obtained inequalities improve some known results.

Summary: In this talk, we show norm inequalities related to the quasi geometric mean of negative power, the chaotic geometric mean and $A^{1-\beta}B^{\beta}$ for positive definite matrices A, B.

Summary: Let A and B be bounded positive invertible operators on a Hilbert space, $n \in \mathbb{N}$, α, $\mu \in [0,1]$ and $r \in [-1,1]$. We regard power mean $A \sharp_{\mu,r} B \equiv A^{\frac{1}{2}}\{(1-\mu)I + \mu(A^{\frac{-1}{2}}BA^{\frac{-1}{2}})^r\}^{\frac{1}{r}}A^{\frac{1}{2}}$ as a path connecting A and B. As relative operator entropies on the path $A \sharp_{\mu,r} B$,

$$S_{\alpha,r}(A|B) \equiv A^{\frac{1}{2}}\left(\left\{1-\alpha+\alpha(A^{\frac{-1}{2}}BA^{\frac{-1}{2}})^r\right\}^{\frac{1}{r}-1}\cdot\frac{(A^{\frac{-1}{2}}BA^{\frac{-1}{2}})^r-I}{r}\right)A^{\frac{1}{2}}$$

and $T_{\alpha,r}(A|B) \equiv \frac{A \sharp_{\alpha,r} B - A}{\alpha}$ $(\alpha \neq 0)$, $T_{0,r}(A|B) \equiv \lim_{\alpha \to +0} T_{\alpha,r}(A|B)$ are known. In this talk, we define the n-th relative operator entropies $S^{[n]}_{\alpha,r}(A|B)$ and $T^{[n]}_{\alpha,r}(A|B)$ based on the Taylor's expansion of the path $A \natural_{\mu,r} B$ and show some properties of them.

14:15–15:45

32 Yusuke Sawada (Nagoya Univ.) E_0-semigroups and product systems of W*-bimodules ··············· 15

Summary: Arveson have introduced the notion of product systems and classified E_0-semigroups on type I factors. We shall classify E_0-semigroups on a general von Neumann algebra by product systems of W*-bimodules. The classification is reflected by Bhat–Skeide's one.

33 Kengo Matsumoto (Joetsu Univ. of Edu.) * Flip conjugacy of topological Markov shifts and Ruelle C^*-algebras ··· 15

Summary: We introduce the notion of asymptotic flip conjugacy, which implies asymptotic continuous orbit equivalence,and show that flip conjugate Smale spaces are asymptotically flip conjugate. Several equivalent conditions of asymptotic flip conjugacy of Smale spaces in terms of their groupoids and their Ruelle algebras with dual actions are presented. We finally characterize the flip conjugacy classes of irreducible two-sided topological Markov shifts in terms of the associated Ruelle algebras with its C^*-subalgebras.

34 Hiroyuki Osaka (Ritsumeikan Univ.) Tamotsu Teruya (Gunma Univ.) The Rokhlin property for inclusions of C*-algebras ················· 15

Summary: Let $P \subset A$ be an inclusion of σ-unital C*-algebras with a finite index in the sense of Pimsner–Popa. Then we introduce the Rokhlin property for a conditional expectation E from A onto P and show that if A is simple and satisfies any of the property like pure infiniteness, stable rank one, real rank zero, the nuclear dimension n, $\mathcal{D}$-absorption for a strongly self-absorbing C*-algebra $\mathcal{D}$, simplicity, AF, AI, AT-properties, the strict comparison property for Cuntz semigroup, and E has the Rokhlin property, then so does P.

35 Yasuhiko Sato (Kyoto Univ.) Calculations of nuclear dimension for amenable C*-algebras ········· 15

Summary: The nuclear dimension is a relatively new concept introduced by E. Kirchberg, W. Winter, J. Zacharias. Currently, it is regarded as a central research subject of classification theory of nuclear C*-algebras and attracts the attention of many researchers. In my research so far, we have used the von Neumann algebraic approach to calculate the finiteness of nuclear dimensions and calculated it. In this presentation, we give a calculation method of nuclear dimensions by C*-algebraic theory and clarify the nature of nuclear dimensions and other associated ranks. Besides, we try to refine the calculation of nuclear dimensions for crossed products obtained from the dynamical system of C*-algebras.

36 Tsuyoshi Kajiwara (Okayama Univ.) Yasuo Watatani (Kyushu Univ.) Dimension group of the C*-algebra associated with the Sierpinski gasket ··· 15

Summary: In this talk, we present a method to represent the dimension group of the core of the C*-algebra associated with the self similar map giving the Sierpinski gasket, which is a typical example of self similar figure, using model traces on the core. For the case of the Sierpinski gasket, we need values of generators of K-group of the core at the three series of model traces.

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

Yuki Arano (Kyoto Univ.) ♭ Actions of tensor categories

Summary: I will overview how the quantum group techniques can be applied to the subfactors. First we observe that the classification of subfactors can be interpreted as a classification of actions of tensor categories, which can be seen as a slight generalization of actions of quantum groups and I will present some results on this direction. Then I explain approximation properties of tensor categories which is important in such classification.

Statistics and Probability

March 17th (Sun) Conference Room VIII

9:30–12:00

1 Hiroki Takahashi (Keio Univ.) Equi-distribution theorem for the Gauss map ····· 15

Summary: We show that weighted periodic points and iterated preimages of the Gauss map are qui-distributed according to the Gauss map. Our proof is based on the Large Deviation Principle and the uniqueness of the minimizer of the corresponding rate function.

2 Hajime Kaneko (Univ. of Tsukuba) Comparison of normality between different numerical systems ····· 15
Shigeki Akiyama (Univ. of Tsukuba)
Dong Han Kim (Dongguk Univ.)

Summary: In this talk, we study the condition for normal numbers in numerical systems. Let b be an integer greater than 1 and r, s positive integers. Maxfield showed for any real number x that x is normal in base b^r if and only if x is normal in base b^s. Recall that normal numbers in base b are denoted in terms of generic points of a certain dynamical system. The main purpose of this talk is to compare the generic points of two ergodic measure preserving systems. Using our main results, we obtain that the sets of the generic points in certain two different ergodic measure preserving systems coincide.

3 Johannes Jaerisch (Shimane Univ.) Dimension gaps in transient dynamics on the real line ····· 15
Maik Gröger (Univ. Vienna)
Marc Kesseböhmer (Univ. Bremen)

Summary: We investigate recurrent and transient behavior for expanding maps on the real line. Our results provide a one-dimensional model for the phenomenon of dimension gaps which occur for limit sets of Kleinian groups. We use ergodic theory and in particular, thermodynamic formalism.

4 Naoto Shimaru (Okayama Univ. of Sci.) On discrepancies of irrational rotations with several large partial quotients ····· 15
Keizo Takashima (Okayama Univ. of Sci.)

Summary: We give some estimates for discrepancies of irrational rotations with several large partial quotients and report unusual aspects of the behavior of discrepancies caused by several large partial quotients.

5 Kenkichi Tsunoda (Osaka Univ.) Scaling limits for Glauber–Kawasaki processes ····· 15

Summary: We discuss scaling limits for Glauber–Kawasaki dynamics. The Glauber–Kawasaki dynamics has been introduced by De Masi et al. to derive a reaction-diffusion equation from a microscopic particle system. In fact, they derived a reaction-diffusion equation as a limiting equation of the density of particles. This limit is usually called hydrodynamic limit. In this talk, we focus on several scaling limits related to this hydrodynamic limit.

6 Mao Shinoda (Keio Univ.) Non-convergence of equilibrium measures for a locally constant function ····· 15

Summary: We consider the sequence of equilibrium measures for a given function parametrized by temperature. Temperature controls ordered and disordered powers, the potential function and entropy. The lower temperature the goes, the more the potential function effects strengthen. In this talk we pay attention to behavior of equilibrium measures as the temperature goes to zero. A fundamental problem in the zero temperature limit is the convergence of equilibrium measures. In the one-dimensional case, the sequence of equilibrium measures for a locally constant function converges. However in the high-dimensional case, there exists a locally constant function whose sequence of equilibrium measures does not converge. We construct such a locally constant function in dimension two by imbedding a one-dimensional effective subshift into a two-dimensional subshift of finite type.

7 Yosuke Kawamoto (Fukuoka Dental Coll.) Dynamical transitons between universal infinite particle systems related to random matrices 15

Summary: There are three typical random point fields with infinitely many particles in log-gases on 1-dimimension, that is, the Bessel, the Airy, and the sine random point fields. Furthermore there exists transition relations between the three random point fields. In this talk, we discuss dynamical version of the transition relations.

8 Shota Osada (Kyushu Univ.) Tree representations of continuum determinantal point processes and tail triviality 15

Summary: Determinantal point processes (DPPs) appear in various models such as uniform spanning trees, uniform lozenge tilings, eigenvalues of random matrices. The former two are DPPs on discrete spaces, and the last is on continuum spaces. There are some interesting properties which are proved only in discrete cases. Tail triviality is one of them. We consider a DPP μ on a continuum space S with an Hermitian symmetric kernel function $K : S \times S \to \mathbb{C}$. We prove tail triviality of μ by constructing tree representations, that is, discrete approximations of determinantal point processes enjoying a determinantal structure.

14:15–15:05

9 Akihito Hora (Hokkaido Univ.) Effect of microscopic pausing time distributions on the evolution of limit shapes of random Young diagrams 15

Summary: We consider (not necessarily Markovian) continuous time random walks on Young diagrams as microscopic dynamics keeping the Plancherel measures invariant. We derive evolution of macroscopic profiles under diffusive scaling limit by using free probability and harmonic analysis on the symmetric group. Furthermore we illustrate an anomalous phenomenon observed with a pausing time obeying a heavy-tailed distribution without the mean.

10 Toshihiro Uemura (Kansai Univ.), Rene Schilling (TU Dresden) Homogenization of symmetric Lévy processes on $\mathbb{R}^d$ 15

Summary: In this talk, we show homogenization of symmetric d-dimensional Lévy processes. Homogenization of one-dimensional pure jump Markov processes has been investigated by Tanaka et al.; their motivation was the work by Bensoussan et al. on the homogenization of diffusion processes in $\mathbb{R}^d$.
We investigate a similar problem for a class of symmetric pure-jump Lévy processes on $\mathbb{R}^d$ and we identify —using Mosco convergence— the limit process.

11 Sergio Albeverio (Bonn Univ.), Minoru Yoshida (Kanagawa Univ.) Non-local Dirichlet forms on infinite dimensional topological vevtor spaces 15

Summary: General theorems on the closability and quasi-regularity of non-local Markovian symmetric forms on probability spaces $(S, \mathcal{B}(S), \mu)$, with S weighted l^2-spaces, $\mathcal{B}(S)$ the Borel σ-field of S, and μ a Borel probability measure on S, are introduced. A family of non-local Markovian symmetric forms $\mathcal{E}_\alpha$, $0 < \alpha \leq 1$, acting in each given $L^2(S;\mu)$ is defined, the index α characterizing the order of the non-locality. It is shown that all the forms $\mathcal{E}_\alpha$ defined on $\bigcup_{n\in\mathbb{N}} C_0^\infty(\mathbb{R}^n)$ are closable in $L^2(S;\mu)$, and sufficient conditions, under which the closure of the closable forms (Dirichlet forms), become quasi-regular, are given. Then, an existence theorem of α-stable type Hunt processes properly associated to the Dirichlet forms is given. As an application of the theorems, the problem of stochastic quantizations of Euclidean Φ^4_3-fields by means of α-stable type Hunt processes is discussed.

15:20–16:20 Award Lecture for the 2018 MSJ Analysis Prize

Norio Konno (Yokohama Nat. Univ.) From interacting particle systems to quantum walks

Summary: Quantum walk is a quantum version of random walk and has been extensively studied since around 2000. A striking property of the quantum walk is the spreading property. The standard deviation of the walker's position grows linearly in time, quadratically faster than random walk, i.e., ballistic spreading. On the other hand, a walker stays at the starting position: localization occurs. In this talk, as an autobiographical sketch of my life, I address a route to my work on quantum walks via my previous work on interacting particle systems. Therefore, my title is "From interacting particle systems to quantum walks". Moreover, due to the rapid development of quantum computer by huge IT companies recently, it has become a reality that programs based on quantum walks run on quantum computers. Finally, I briefly explain the recent trends.

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

Khanh Duy Trinh (Tohoku Univ.) Gaussian beta ensembles in global regime

Summary: As a generalization of Gaussian orthogonal/unitary/symplectic ensembles, Gaussian beta ensembles, one of the most studied models in random matrix theory, were originally defined in terms of the joint density of eigenvalues. They have been studied by using some methods in statistical mechanics since the distributions of eigenvalues can be viewed as the equilibrium measures of a one-dimensional Coulomb log-gas with an external Gaussian potential. Gaussian beta ensembles are now realized as eigenvalues of certain random tridiagonal matrices. Since the discovery of the random matrix models, many new spectral properties of Gaussian beta ensembles have been established. This talk gives a brief survey on recent developments with emphasizing on the global regime which deals with the convergence to a limiting measure, and the fluctuation around the limit of the empirical distributions.

March 18th (Mon) Conference Room VIII

10:00–11:20

12 Satoshi Suzuki (Shimane Univ.) Optimality conditions for quasiconvex programming in terms of subdifferentials · · · · · 15

Summary: In this talk, we study optimality conditions for quasiconvex programming in terms of subdifferentials. We show a necessary and sufficient optimality condition for essentially quasiconvex programming in terms of Greenberg–Pierskalla subdifferential. We introduce a necessary and sufficient optimality condition for non-essentially quasiconvex programming in terms of Martínez-Legaz subdifferential. Additionally, we show a necessary optimality condition for quasiconvex programming with a reverse quasiconvex constraint in terms of Greenberg–Pierskalla subdifferential.

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

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

14 Takahiro Tsuchiya (Univ. of Aizu), Dai Taguchi (Osaka Univ.) Forward-backward stochastic differential equations and Newton's method · · · · · 15

Summary: We propose the Newton–Kantorovitch method for solving partially coupled forward-backward stochastic differential equations (FBSDEs) involving smooth coefficients with uniformly bounded derivatives. We show the global convergence property with respect to $T > 0$, moreover, it is quadratic convergence.

15 Yuji Yoshida (Univ. of Kitakyushu) Risk measures derived from utility functions · 15

Summary: Coherent risk measures in financial management are discussed from the view point of average value-at-risks with risk spectra. A minimization problem of the distance between risk estimations through decision maker's utility and coherent risk measures with risk spectra is introduced. The risk spectrum of the optimal coherent risk measures in this problem is obtained and it inherits the risk averse property of utility functions. Various properties of coherent risk measures and risk spectrum are demonstrated.

16 Ryoichi Suzuki (Keio Univ.) Local risk-minimization for digital options in Lévy markets via Malliavin calculus · 10

Summary: In this talk, we first consider Malliavin differentiability of indicator functions on canonical Lévy spaces. By using it, we obtain explicit representations of locally risk-minimizing hedging strategy for digital options in markets driven Lévy processes.

11:30–12:00 Research Section Assembly

March 19th (Tue) Conference Room VIII

9:45–12:00

17 Yuichi Goto (Waseda Univ.) Bivariate asymptotic theory of nonparametric estimation based on binary time series · 10

Summary: Binary time series is the time series converted into 0 and 1. In this talk, a strictly stationary ellipsoidal alpha-mixing bivariate process with mean zero and finite variance is discussed. We consider the estimation problems of the functional spectra of a bivariate time series by using binary time series. First, we show the consistency of our estimator. Next, we elucidate the joint asymptotic distribution of our estimator.

18 Yujie Xue (Waseda Univ.) Modified LASSO estimators for linear quantile regression models with long-memory disturbances · 10

Summary: It is the fundamental task of statistics to find out internal relationship of diversity of scientific observations. Quantile regression offers the opportunity for a more complete view of the relationships among stochastic variables. In this talk, the properties of modified LASSO estimators for linear quantile regression models is discussed when the disturbances are long-memory which implies the dependence on the disturbances before decays very slowly. We derive the asymptotic distributions of the estimators when there is no nonzero parameters and also derive the property of the estimators when nonzero parameters exist under some appropriate regularity conditions.

19 Hideaki Nagahata (Inst. of Stat. Math./Waseda Univ.) Higher-order approximation of the distribution of test statistics for high-dimensional time-series ANOVA models · 15

Summary: Analysis of variance (ANOVA) is tailored for independent observations. Recently, there has been considerable demand for the ANOVA of high-dimensional and dependent observations in many fields. Thus, it is important to analyze the differences among big data's averages of areas from all over the world, such as the financial and manufacturing industries. However, the numerical accuracy of ANOVA for such observations has been inadequately developed. Thus, herein, we study the Edgeworth expansion of distribution of ANOVA tests for high-dimensional and dependent observations. Specifically, we present the second-order approximation of classical test statistics proposed for independent observations. We also provide numerical examples for simulated high-dimensional time-series data.

Summary: We consider a test for missingness in time series. Suppose we observe a time series with missing values, which is generated by a regression model with dependent disturbances. The mechanism for the missing values is supposed to be generated by Bernoulli responses from a generalized linear ARMA model. We propose a test statistic for a score type test for the null hypothesis that the data are missing completely at random. For this testing problem, we use the Laplace approximation to obtain the likelihood of the process. We investigate the performance of our proposed test statistic in several numerical simulations. The method is also applied to real data of pollution levels containing some missing observations.

Summary: Statistical treatment of a circular observation has attracted much attention in these decades, and such data is often observed in variety of fields. This talk constructs an L_1-based local polynomial regression estimator for a nonlinear regression function of circular random variables. We use a circular kernel to approximate the regression function by a polynomial function locally. The novel aspect of this talk is that we allow the dependent structure and possibly infinite variance of the error process. The result in Di Marzio, Panzera and Taylor (2009) is then nicely extended to infinite variance dependent innovation case. Some simulation experiments illustrate the finite sample performance of the proposed method and elucidate robustness of the proposed L_1-based estimator.

Summary: Weak convergences of marked empirical processes in $L^2(\mathbb{R}, \nu)$ and their applications to statistical goodness-of-fit tests are provided, where $L^2(\mathbb{R}, \nu)$ is the set of equivalence classes of the square integrable functions on $\mathbb{R}$ with respect to a finite Borel measure ν. The results obtained in our framework of weak convergences are, in the topological sense, weaker than those in previous works. However, our results have the following merits: (1) avoiding conditions which do not suit for our purpose; (2) treating a weight function which make us possible to propose an Anderson–Darling type test statistics for goodness-of-fit tests. Indeed, applications are novel.

Summary: In this talk, we consider testing high-dimensional covariance structures: (i) diagonal matrix and (ii) intraclass covariance matrix. We produce a test statistic for each covariance structure 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 ECDM test statistics have a consistency property and hold the asymptotic normality. We propose a new test procedure based on the ECDM test statistic for each hypothesis and evaluate its size and power asymptotically.

Summary: There are many versions of Bayesian Cramér–Rao type lower bounds of the Bayes risk. We compare them from the point of view of asymptotic optimality. We show that the asymptotic optimality result of Abu-Shanab and Veretennikov (2015) still holds true in the sense of Bhattacharyya type lower bound of Koike (2006) in univariate case. And we show the asymptotic optimal choice in the lower bound of Gill and Levit (1996) in multivariate case.

14:15–15:00

25 Gaku Igarashi (Univ. of Tsukuba) Boundary-bias-free direct density ratio estimation using beta kernel · · 15

Summary: Ćwik and Mielniczuk (1989) suggested a nonparametric direct density ratio estimator based on the kernel density estimator. However, their direct density ratio estimator is inconsistent near the boundary, similarly to the kernel density estimator. In this talk, the asymptotic properties of a direct density ratio estimator based on the beta kernel density estimator, which is free of boundary bias, are studied.

26 Yoshihide Kakizawa (Hokkaido Univ.), Gaku Igarashi (Univ. of Tsukuba) Higher-order bias corrections for asymmetric kernel density estimators · · · 15

Summary: Asymmetric kernel density estimation has been well-studied in the literature. In this talk, extending several bias reduction methods with $n^{-8/9}$-MISE, it is shown that some asymmetric kernel density estimators can be easily bias-corrected up to the higher-order, in an additive or multiplicative way. We prove that new higher-order bias-corrected asymmetric kernel density estimators have the desirable asymptotic properties under suitable conditions.

27 Yoshihiko Maesono (Kyushu Univ.), Rizky Reza Fauzi (Kyushu Univ.) Boundary-free Kolmogorov–Smirnov test based on kernel estimation · · · 10

Summary: In this talk, we propose a new Kolmogorov–Smirnov type test which is based on kernel estimation. The new test statistics is based on a boundary-free kernel test. We discuss asymptotic properties of the statistic and compare powers of the ordinal and new Kolmogorov–Smirnov tests by simulation.

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

Aki Ishii (Tokyo Univ. of Sci.) High-dimensional statistical inference under the strongly spiked eigenvalue model

Summary: We consider statistical inference for high-dimension, low-sample-size (HDLSS) data. It is very important for HDLSS data that one selects a suitable procedure depending on the high-dimensional eigenstructures. Aoshima and Yata (2018, Sinica) proposed two eigenvalue models for high-dimensional data. One is called strongly spiked eigenvalue (SSE) model and the other one is called non-SSE (NSSE) model. A lot of theories and methodologies for HDLSS data have been developed under the NSSE model. In this talk, we focus on the SSE model that is often seen when we analyze microarray data sets. We give new theories and procedures under the SSE model. As for the SSE model, usually, one cannot discuss the asymptotic normality. In order to overcome this problem, Ishii, Yata and Aoshima (2016, JSPI) newly gave asymptotic distribution of the largest eigenvalue. On the other hand, Aoshima and Yata (2018, Sinica) gave the data-transformation technique that transforms the SSE model into the NSSE model. By using the high-dimensional asymptotics and the data-transformation technique, we construct new two sample test procedures, equality tests of two covariance matrices, classification procedures and so on. We also give numerical results of our new procedures and demonstrations by using microarray data sets.

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

Kiyotaka Iki (Nihon Univ.) Symmetry models based on an underlying bivariate distribution for square contingency tables

Summary: For the analysis of square contingency tables with the same row and column ordinal classifications, this presentation proposes new models, which may be appropriate for a square contingency table if it is reasonable to assume an underlying bivariate distribution. These models have characteristics that the cell probabilities have a similar structure of underlying bivariate distribution. The simulation studies based on some bivariate distributions are given.

March 20th (Wed) Conference Room VIII

9:30–12:00

28 Mitsuhiro Takami (Tokyo Univ. of Sci.)
Yusuke Saigusa (Yokohama City Univ.)
Aki Ishii (Tokyo Univ. of Sci.)
Tomoyuki Nakagawa (Tokyo Univ. of Sci.)
Sadao Tomizawa (Tokyo Univ. of Sci.)

Geometric mean type measure of symmetry for square contingency tables with ordered categories 10

Summary: We shall propose a new measure of symmetry for square contingency tables having ordered categories. The measure is expressed as a weighted geometric mean of the diversity index. The proposed measure is useful for comparing the degrees of departure from partial symmetry between two different ordinal tables.

29 Toshiki Takei (Tokyo Univ. of Sci.)
Aki Ishii (Tokyo Univ. of Sci.)
Tomoyuki Nakagawa (Tokyo Univ. of Sci.)
Sadao Tomizawa (Tokyo Univ. of Sci.)

Geometric mean type measure of marginal homogeneity for square contingency tables with ordered categories 10

Summary: We propose a new measure of marginal homogeneity for square contingency tables with ordered categories. The measure is expressed as a weighted geometric mean of the diversity index. In this talk,we show some properties of the proposed measure and give its confidence interval.

30 Satoru Shinoda (Tokyo Univ. of Sci./Taisho Pharmaceutical Co., Ltd.)
Kouji Tahata (Tokyo Univ. of Sci.)
Kiyotaka Iki (Nihon Univ.)
Sadao Tomizawa (Tokyo Univ. of Sci.)

Marginal inhomogeneity based on complementary log-log transform for multi-way contingency table 10

Summary: For multi-way contingency tables with ordered categories, we are interested in considering the marginal homogeneity model which indicates the structure of equality of marginal distributions (Agresti, 2002, p. 440; Bhapkar and Darroch, 1990). When the marginal homogeneity model does not fit for the data, we are also interested in seeing the structure of inhomogeneity of marginal distributions. So, some extensions of the marginal homogeneity model were proposed. This presentation proposes two models using the complementary log-log transform. It also gives the decompositions of the marginal homogeneity model into the proposed model and a model of the equality of marginal means.

31 Takuya Yoshimoto (Tokyo Univ. of Sci./Chugai Pharmaceutical Co., Ltd.)
Kouji Tahata (Tokyo Univ. of Sci.)
Kiyotaka Iki (Nihon Univ.)
Sadao Tomizawa (Tokyo Univ. of Sci.)

Moment symmetry model and decomposition of marginal symmetry model for multi-way contingency tables 15

Summary: For the analysis of square contingency table, Yoshimoto, Tahata, Iki and Tomizawa (2018) considered the covariance symmetry model and pointed out that the symmetry model holds if and only if both the covariance symmetry model and the marginal homogeneity model hold. This presentation proposes the moment symmetry model and the decomposition theorem of the marginal symmetry and symmetry models for multi-way contingency tables. The moment symmetry model and decomposition theorem are the generalization of the result given by Yoshimoto et al. (2018).

Summary: For the analysis of multidimensional contingency tables with ordinal categories, our interest is whether each marginal distribution is homogeneous or not. It may be more appropriate to apply a certain marginal inhomogeneity model when the marginal homogeneity model does not fit. In this report, we propose the generalized marginal inhomogeneity model using a continuous strictly increasing function. Using this model, we prove that the marginal homogeneity model is decomposed into two models. The decomposition is useful to deduce the reason for the poor fit when the marginal homogeneity model fits poorly.

Summary: We consider the testing problem for a mean vector when the data matrix is of the monotone missing pattern. The simplified T^2-type test statistic for this problem has been derived by Krishnamoorthy and Pannala (1999) and Yagi et al. (2018). Further, its null distribution was given in the form of an asymptotic expansion and the transformation for the test statistic was derived by Yagi et al. (2018). In this talk, we propose a new test statistic designed based on the above result. Further, we present the approximation to the upper percentiles of this statistic and propose the transformed test statistics. Finally, by a Monte Carlo simulation, we investigate the accuracy and asymptotic behavior of the approximation for χ^2 distribution.

Summary: In three dimensional contingency tables, test of complete independence, test of independence between one factor and the other two and test of conditional independence are important and interesting problems. In this report, we consider improvement of usual test statistics of above independencies by using Bartlett-type transformation and improved transformation.

Summary: Event-related functional Magnetic Resonance Imaging (efMRI) enables us to estimate the peak of the hemodynamic response function (HRF), describing changes in the blood oxygen level dependent (BOLD) to neural activity in response to mental stimuli. As a good candidate of arrays providing highly efficient designs of stimuli, Lin–Phoa–Kao (2017) introduced the concept of circulant almost orthogonal array (CAOA). Yoshida–Satake–Phoa–Sawa (2018) gave a systematic construction of CAOA with strength 3 by using cyclic Hadamard 2-designs. When we construct CAOA by using Paley's 2-designs, we must find suitable subsequences in the characteristic sequence of quadratic residues modulo primes. In this talk, we investigate the location of such subsequences.

Summary: In this talk we are mainly concerned with a class of cubature formulas with respect to rotationally invariant bivariate integrals, which has been traditionally studied in numerical analysis, combinatorics and design of experiments. The aim of this talk is to mention an algebraic motivation for a certain result recently obtained as a joint work with Masatake Hirao.

14:15–16:00

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 constructions of dropout designs using projective spaces or affine spaces.

Summary: The concept of a splitting-balanced block design (SBD) has been defined with some applications for authentication codes in Ogata et al. (2004). Most of the SBDs obtained in literature contain many repeated subblocks. From a point of view for some applications it is preferable that the design here has no repeated subblocks. In this talk, a splitting-balanced packing-block design (SPD) is newly defined, and also direct and recursive constructions of a $(v, 2 \times 2, 1)$-SPD with a cyclic automorphism are provided. It is finally shown that there exists a cyclic $((2P-1)Q, 2 \times 2, 1)$-SPD, where P is any product of primes p with each $p \equiv 1 \pmod 4$ and Q is any product of primes q with each $q \equiv 1 \pmod 8$.

Summary: We consider the third-order linear model for 3^m factorials. Let T be a 3^m-BTO design of resolution R*({10, 01}) derived from an SA$(m; \{\lambda_{xm-x-yy}\})$ with N assemblies and $m \geq 6$. Further let $\sigma^{4m} D_T$ be the determinant of the variance-covariance matrix of the estimators concerning with all the main effects based on T. If $D_T \leq D_{T^*}$ for any T^*, then T is said to be D*-optimal, where T^* is a 3^m-BTO design of resolution R*({10, 01}) derived from an SA with N assemblies. In this talk, we give D*-optimal 3^m-BTO designs of resolution R*({10, 01}) derived from SA's for $6 \leq m \leq 8$, where $N < \nu(m)$. Here $\nu(m)$ is the number of non-negligible factorial effects.

Summary: The concept of spherical design is introduced by Delsarte–Geothals–Seidel (1977). There exist several works on spherical design, e.g., the relationships of experimental design or cording theory. However, as far as the authors know, there exist few studies on spherical-cap cases. In this talk, the new concept of spherical-cap design is firstly introduced as a generalization of spherical design. Secondary, the lower bounds of number of points in a spherical-cap design and tight spherical-cap design, which attains such a lower bound, are discussed. Finally, several examples of spherical-cap designs are presented and some applications of such designs are discussed if possible.

Summary: The concept of almost tight Euclidean design, which is a union of the origin and a tight design satisfying $0 \notin X$, is introduced by Bannai et al (2010). As far as the authors know, there exist few studies on characterization of such designs for circularly symmetric integrals. In this talk we give a necessary condition for the existence of such designs in terms of near Gaussian quadrature formulas for the radial component of a circularly symmetric integral. In particular, we focus on four types of Jacobi weights and give several examples of such designs.

Summary: Spherical designs are "good" point sets which give exact numerical integration rules for spherical polynomials. There exist many works on how to construct such designs. For example, Yamamoto et al (2018) discusses a method of constructing such designs using the hyperoctahedral group orbits of corner vencors and the internally dividing points and presents such designs. In this talk, we give a generalization of their method and several examples of such designs. In particular, we note that the list of known minimum points of spherical design has been improved in some examples.

Applied Mathematics

March 17th (Sun) Conference Room I

9:00–12:10

1 Shunji Horiguchi — Sets of initial values converging at the roots of the extended complex Newton method for $z^3 = 1$ ····· 15

Summary: We extend the complex Newton method. We give the followings for the extended complex Newton method. A relationship between the extended complex Newton method and the Riemann surface. The distribution of roots of extended complex Newton method for $z^3 = 1$. Sets of initial values converging at the roots of the extended complex Newton method for $z^3 = 1$.

2 Shigeyoshi Ogawa (Ritsumeikan Univ.) — A Lagrangian numerical scheme for the noncausal stochastic integral ····· 10

Summary: We are concerned with the numerical evaluation problem of the noncausal stochastic integral with respect to Brownian motion $W_t(\omega)$ of a random function $f(t,\omega)$; $I(f) = \int_0^T f(t,\omega) d_* W_t$. More precisely we intend to construct, on the basis of finite number of observation data $\{f(t_k,\omega), 0 = t_0 < t_1 < \cdots < t_n = T\}$, a numerical scheme whose precision level can be much better than $O(\frac{1}{\sqrt{n}})$. For this purpose we restrict our attention to such a special case where the integrand is of the form $f(t,\omega) = g(W_t(\omega))$ with unknown function $g(x)$. We develop the discussion in the framework of the noncausal theory of stochastic calculus. The aim of the talk is to present a simple but rapide numerical scheme for the stochastic integral.

3 Hirotake Yaguchi (Mie Univ.*)* — Rate of convergence to invariant density function for distribution of iterated beta transformation and linear mod 1 transformation ····· 15

Summary: The β-transformation T_β and the linear mod 1 transformation $T_{\beta,\alpha}$ are transformations on [0,1) defined by $T_\beta(t) = \beta t - \lfloor \beta t \rfloor$ and $T_{\beta,\alpha}(t) = \beta t + \alpha - \lfloor \beta t + \alpha \rfloor$ $(\beta > 1,\ 0 < \alpha < 1)$. We consider how fast the distribution of $T_\beta^k([0,1))$ and $T_{\beta,\alpha}^k([0,1))$ approaches to its invariant density, and give explicit rate of convergence to invariant density function using β or β and α. The proof is proceeded by counting the number of same kind of lines which appear in the graph of $T_\beta^k([0,1))$ or $T_{\beta,\alpha}^k([0,1))$. The base of proof is to show that the ratio of two numbers (or a sum of some numbers) obtained above approaches to β^{-j} as $k \to \infty$.

4 Isamu Ohnishi (Hiroshima Univ.)
Masayasu Mimura (Musashino Univ.)
Rein van der Hout
Danielle Hilhorst (Univ. Paris-Sud) — Existence theorem of time global solution of modified Keller–Rubinow model for Liesegang phenomena by use of subdifferential ····· 10

Summary: Liesegang Phenomena is a kind of typical "Reaction-Diffusion" system with precipitation of resulting stuff of the chemical reaction. When this precipitation occurs, the density of the stuff goes over a certain threshold value, which is called "Saturation Concentration". The precipitation happens suddenly, if the density reaches the threshold value. This is because the nonlinear term of the system of partial differential equations has a kind of "jump", namely discontinuity. We consider that the rate of density variation can take whole value of the width of "jump". We represent it by use of subdifferential notion. Briefly I introduce our work with Prof.s M. Mimira, Rein V. D. Hout, and D. Hilhorst.

5 Yasuhide Uegata (Meiji Univ.)
Shigetoshi Yazaki (Meiji Univ.)
Kazunori Kuwana (Yamagata Univ.)
Maika Goto (Yamagata Univ.)
Mathematical approach to smoldering phenomena on a sheet of paper near floor I : analysis by image segmentation ····· 15

Summary: In this talk, we present the way to determine parameters arising in our model equation by a technique of image segmentation for images taken from a movie of smoldering phenomena of a sheet of paper near floor. Our model equation is an interfacial evolution equation and the normal velocity is a linear combination of a constant, the curvature and its second derivative w.r.to the arc-length. The evolution equation is equivalent to the so-called Kuramoto–Sivashinsky equation for a graph. Unknown parameters are the constant and a coefficient of the curvature, and they will be determined by our technique and compared with the theoretical values.

6 Syunsuke Kobayashi (Meiji Univ.)
Yasuhide Uegata (Meiji Univ.)
Shigetoshi Yazaki (Meiji Univ.)
Mathematical approach to smoldering phenomena on a sheet of paper near floor (II: bifurcation analysis) ····· 15

Summary: The Kuramoto–Sivashinsky equation on a Jordan curve is studied from the view point of local bifurcation analysis and image processing. Recently, it was reported that this model equation is valid for not only propagating gaseous flame fronts but also expanding smoldering fronts over thin solids. In this talk, we focus our attention on the instability at a circle solution, and derive a normal form on center manifold. As a result, we see that a rotation wave bifurcates from a circle solution. The existence of this solution implies that rotating effect is inherent in the smoldering combustion phenomena.

7 Shinya Uchiumi (Gakushuin Univ.)
Masahisa Tabata (Kyushu Univ.*)
Convergence of the Lagrange–Galerkin scheme with numerical quadrature —L^2-estimate of the velocity— ····· 15

Summary: We consider the Lagrange–Galerkin scheme for the Navier–Stokes problem. Because the scheme includes integration of a composite function, it is difficult to implement the scheme exactly. Therefore, the scheme with numerical quadrature is often used in practice. However, the convergence has not been shown. We observed that numerical results of the scheme show instability depending on the time increment. On the other hand, we also observed that the stability is recovered when small time increments are used. Herein we explain the reason. We consider the scheme with quadrature when quadrature points are inside the element and the time increment is sufficiently small. We show results of convergence of the scheme including L^2-estimate of the velocity, and show numerical results that reflect the theoretical result.

8 Masaaki Uesaka (Hokkaido Univ.)
Yoshikazu Giga (Univ. of Tokyo)
Koya Sakakibara (Kyoto Univ./RIKEN)
Kazutoshi Taguchi (Univ. of Tokyo)
On numerical scheme for constrained total variation flows ····· 15

Summary: In this talk, we propose a new numerical scheme for total variation flows whose values are constrained in a Riemannian manifold. Moreover, we prove convergence of time-discretized solution generated by the proposed scheme when initial datum is a piecewise constant function. Finally, we perform numerical results via the proposed scheme.

Summary: Shape optimization requires shape sensitivity analysis, optimization, numerical calculation method. In elasticity, we have built a systematic method using the generalization of J-integral (GJ-integral) for shape sensitivity analysis, H^1-gradient method for optimization and finite element method for numerical calculation method. The feature of this method is a general-purpose method that is applicable even if the solution has singularity. In Stokes problem, we cannot use the method stated just above because of incompressible. We obtain the shape sensitivity analysis for Lagrangian, and derive GJ-integral in Stokes problem. Examples of the calculation will be shown in our talk.

Summary: We characterize some steady solutions of the Euler–Arnold equations and Navier–Stokes–Taylor equations by geometric structures of a surface. We first investigate physical aspects of a hydrodynamic Killing vector field as a steady solution of the Euler–Arnold equations and the Navier–Stokes–Taylor equations from the conformal structure and the singular Riemannian foliated structure generated by the Killing vector field. We compare physical properties of a potential vector field with that of the Killing vector field. Deriving exact solutions and steady solutions with singular vorticities and exact infinitesimal flux, we discuss them in terms of geometric structures of a surface.

Summary: The harmonic measure is closely related to the Dirichlet boundary value problem of the Laplace equation. Moreover, it appears in probability theory and harmonic analysis, so the study of the harmonic measure is recognized to be an important topic. It is desirable to obtain an analytic form of the harmonic measure, however, it is impossible in general, so numerical study also plays a key role. In this talk, we construct a numerical scheme for computing harmonic measure on a closed surface based on the method of fundamental solutions and compare numerical results with analytic ones.

Summary: We use a simple model of the dynamics of an inviscid vortex sheet desribed by the Birkhoff–Rott equation to gain some fundamental insights about the potential for stabilization of shear layers using feedback control. Let us consider two arrays of point sinks/sources located a certain distance above and below the vortex sheet as actuators subject to the mass conservation. We demonstrate using analytical computations that the Birkhoff–Rott equation linearized around the flat-sheet configuration is in principle controllable. Second, we design a state-based LQR stabilization strategy with using high precision arithmetics.

12:30–12:45 Presentation Ceremony for the 2018 MSJ Prize for Excellent Young Applied Mathematicians

14:15–16:55

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 robust to changes in the given persistence module. Our motivation is to derive the algebraic stability theorem for the zigzag persistence module. It is not easy to prove it directly. It is known that the derived category of the persistence module and the zigzag one are equivalent. Thus our strategy is to derive the algebraic stability theorem for the zigzag persistence module from the ordinary one by using the derived category. In this talk, we will discuss the algebraic stability theorem for the derived category of the persistence module.

Summary: Percolation theory is a branch of probability theory which describes the behavior of clusters in a random graph. Recently, craze formation in polymer materials is gaining attention as a new type of percolation phenomenon in the sense that a large void corresponding to a craze of the polymer starts to appear by the process of coalescence of many small voids. In this talk, I introduce a new percolation model motivated from the craze formation of polymer materials. For the sake of modeling the coalescence of nanovoids, this model focuses on clusters of holes, which are formulated as homology generators in codimension one, while the classical percolation theory mainly studies clusters of vertices (i.e., 0-dimensional objects).

Summary: A recent work by Lesnick and Wright proposed a visualisation of 2D persistence modules by using their restrictions onto lines, giving a family of 1D persistence modules. We explore what 1D persistence modules can be obtained as a restriction of indecomposable 2D persistence modules to a single line. To this end, we give a constructive proof that any 1D persistence module can in fact be found as a restriction of some indecomposable 2D persistence module. As another consequence of our construction, we are able to exhibit indecomposable 2D persistence modules whose support has holes.

16 Hideto Asashiba (Shizuoka Univ.)
Mickaël Buchet (Graz Univ. of Tech.)
Emerson Gaw Escolar (RIKEN/Kyoto Univ.)
Ken Nakashima (Shizuoka Univ.)
Michio Yoshiwaki (RIKEN/Kyoto Univ./Osaka City Univ.)
On interval decomposability of 2D persistence modules 15

Summary: In persistent homology of filtrations, the indecomposable decompositions provide the persistence diagrams. In multidimensional persistence it is known to be impossible to classify all indecomposable modules. One direction is to consider the subclass of interval-decomposable persistence modules, which are direct sums of interval representations. We introduce the definition of pre-interval representations, a more algebraic definition, and study the relationships between pre-interval, interval, and indecomposable thin representations. We show that over the "equioriented" commutative 2D grid, these concepts are equivalent. Moreover, we provide an algorithm for determining whether or not an nD persistence module is interval/pre-interval/thin-decomposable, under certain finiteness conditions and without explicitly computing decompositions.

17 Tomoki Uda (Tohoku Univ.)
Takashi Sakajo (Kyoto Univ.)
Tomoo Yokoyama (Kyoto Univ. of Edu.)
Discrete forumulation of Reeb graphs and its application to topological flow data analysis 15

Summary: We propose a discrete theory and a construction algorithm of Reeb graphs in which finite 2D data are sampled from real-valued functions. Owing to their natural derivation, we can bridge a gap between discreteness and continuity in the Reeb graph problem. Since the theory is based on so-called merge trees of 0-th persistent homology for sublevelset and superlevelset filtrations, stability of the algorithm is to be expected. We also show an application to Yokoyama's tree-representation theory for topological fluid dynamics in which we have one-to-one correspondence between labeled trees and 2D Hamiltonian flows under topological classification. Although tree-representations are computed by hand in preceding studies, we have established a conversion algorithm using our Reeb graph theory.

18 Yuki Chiba (Univ. of Tokyo)
Discontinuous Galerkin method for Poisson equation with Robin boundary condition on a curved domain 15

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

19 Junji Yamada (Kyoto Univ.)
Mitsuru Shibayama (Kyoto Univ.)
Integrability of planer three-body problem with generalized force under reduction 15

Summary: We consider the planer three-body problem with generalized force. Some non-integrability results for these systems have been obtained by analyzing the variational equations along the homothetic solutions. But we can not apply it to several exceptional cases. For example, when the system has inverse-square potentials the variational equations along the homothetic solutions are always solvable. We obtain sufficiently conditions for non-integrability for these exceptional cases by focusing on some particular solutions that are different from homothetic solutions.

20 Takuya Tsuchiya (Waseda Univ.)
Misa Fukushima (Waseda Univ.)
Gen Yoneda (Waseda Univ.)
Numerical simulations of second order perturbation equations of Einstein equations in Minkowski background 15

Summary: We derive the second order perturbation equations of the Einstein equations in Minkowski background metric. To make simulations with the perturbations equations, we derive the Hamiltonian formualtion of the equations. In addition, we propose a numerical scheme of the equations for calculating precise simulations.

21 Akitoshi Takayasu (Univ. of Tsukuba)
Verified computations for solutions of complex Ginzburg–Landau equations 15

Summary: In this talk, we consider a numerical method for proving the existence of solutions for the complex Ginzburg–Landau equations. Our verification principle is based on the simplified Newton operator for time-dependent Fourier coefficients. We derive a sufficient condition for verifying the simplified Newton operator becomes the contraction mapping on a neighborhood of a numerically computed approximate solution, which is given by Chebyshev–Fourier spectral methods.

22 Yoshitaka Watanabe (Kyushu Univ.)
Takehiko Kinoshita
Nobito Yamamoto
(Univ. of Electro-Comm.)
Mitsuhiro T. Nakao (Waseda Univ.)
A higher order constructive error estimation of the Poisson equation and its applications 15

Summary: A higher order error estimation for the approximate solution of the Poisson equation is presented. The proposed procedure is able to be applicable to residual iteration techniques for the verification of solutions to nonlinear elliptic equations. Some numerical examples by finite element method comparing other approaches will be shown.

17:00–18:00 Talk Invited by Applied Mathematics Section

Xuefeng Liu (Niigata Univ.)
Progress about computer-assisted proof for the stationary solution of Navier–Stokes equation

Summary: As one of the Millennium Prize Problems, the problem of existence and smoothness of the Navier–Stokes equation draws the attention of mathematician from the world. Meanwhile, the verified computing with assistance of computers has proved to be a promising approach to investigate the solution existence to nonlinear equation systems.

In this talk, I will report the latest progress about the solution verification for the stationary Navier–Stokes equation over a non-convex 3D domain. The verification is under the frame of Newton–Kantorovich's theorem along with the quantitative error analysis for the finite element methods. For the kernel problems in applying Newton–Kantorovich's theorem, the following schemes are utilized.

1) To bound the norm of the inverse of a differential operator, the algorithm based on the fixed-point theorem (Nakao, 1999) is utilized.

2) To give the *a priori* error estimation of the projection from solution existing space to finite element spaces, the hypercircle method (Liu–Oishi, 2013) is adopted.

3) The rigorous eigenvalue estimation for differential operators in 3D domain is provided by using the non-conforming finite element method (Liu, 2015).

March 18th (Mon) Conference Room I

9:10–12:10

23 Fumio Nakajima (Iwate Univ.)* Logarithmic potential poperty appeared on the surfaces of Japanese volcanoes 15

Summary: The east profile of Mt. Fuji has a middle part which is approximately represented by the logarithmic curve (Milne, 1878). In this talk we shall show that the east surface of Mt. Fuji and the whole surface of Mt. Kaimondake have respectively their middle parts which are approximately represented by the rotational surfaces around their vertical axes through points of their summits and that their generating curves are the logarithmic curves, by investigating their contour maps with scale of 1:25,000 published by Japan geological agency. Therefore we may observe on these surfaces the logarithmic potential property.

24 Masashi Mizuno (Nihon Univ.)*
Yekaterina Epshteyn (Univ. Utah)
Chun Liu (Illinois Inst. Tech.)
Some evolution equation of grain boundaries with dynamic lattice orientations and with triple junction drag 15

Summary: Motion of grain boundaries with dynamic lattice orientations and with triple junction drag is considered. We derive some evolution equations ensuring dissipation of the grain boundary energy via the energetic variational approach. We take the relaxation limit to the curvature effects on the equations, to take into account of the effect of the dynamic lattice orientations and the triple junction drag, and show the solvability of the relaxation equations.

25 Kei Nishi (Kyoto Sangyo Univ.)
Yasumasa Nishiura (Tohoku Univ.)
Takashi Teramoto (Asahikawa Medical Univ.)
Pulse dynamics in a bistable three-component reaction-diffusion system with a jump-type heterogeneity 15

Summary: The dynamics of a traveling pulse solution arising in a bistable three-component reaction-diffusion system is considered both numerically and analytically. Depending on the parameter values, the traveling pulse exhibits a variety of behavior when it encounters a jump-type spatial heterogeneity. To analytically elucidate its mechanism, four dimensional ODEs are derived by means of multiple scales method, which capture the essential features of the pulse motion observed for the original PDE system. In the talk, we present the numerical results of the heterogeneity-induced pulse behavior, and utilize the reduced ODEs to clarify the mechanism for the pulse dynamics from a viewpoint of bifurcation theory.

26 Masato Kimura (Kanazawa Univ.)
Ryohei Yamaoka (Kanazawa Univ.)
Tetsuya Ishiwata (Shibaura Inst. of Tech.)
Shigetoshi Yazaki (Meiji Univ.)
Two dimensional snow crystal growth model with supersaturation of vapor 15

Summary: We propose a simple two dimensional snow crystal growth model and discuss about its solvability. The model is based on a generalized hexagonal crystalline motion with several singularities such as facet collision, facet merging, facet generation, and facet breaking. It also includes the effect of diffusion of supersaturated vapor and the Gibbs–Thomson law. We prove unique existence of the solution locally in time and give a simple formula to obtain the facet velocity by means of the single layer potential on the facets. In our numerical examples, setting a suitable critical length of the facet, we can observe typical dendritic crystal growth. This work is based on the collaboration with Ryohei Yamaoka, Kanazawa University and his master's thesis.

Summary: In this study, a kind of generalization is proposed 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. This integer-type algorithm, which can solve ODEs only by means of four arithmetic operations among integers, was widely applicable for the higher-order linear ODEs with rational coefficient functions over Q (rational numbers). However, we can widen the range of its applications to the cases where the coefficient functions belong to algebraic extensions of the field of rational functions over Q. For example, some successful numerical examples are given for the Schrödinger equations whose potential functions belong to the simple extension of the field of rational functions which is obtained by adjoining the square root of a positive-valued rational function.

Summary: Determination of whether periodic orbits, homoclinic orbits, first integrals or commutative vector fields may persist under perturbations is one of the most important problems in the field of dynamical systems. In this talk, we give several theorems on necessary conditions for their persistence in general perturbed systems. Moreover, we consider periodic perturbations of one-degree-of-freedom Hamiltonian systems and describe some relationships between our results and the standard Melnikov method for periodic orbits and homoclinic orbits.

Summary: We consider a class of reversible systems and study bifurcations of homoclinic orbits to hyperbolic saddle equilibria. Here we concentrate on the case in which homoclinic orbits are symmetric, so that only one control parameter is enough to treat their bifurcations, as in Hamiltonian systems. We extend the Melnikov method to reversible systems and obtain theorems on saddle-node, transcritical and pitchfork bifurcations of symmetric homoclinic orbits. We illustrate our theory for a four-dimensional system.

Summary: In this talk, we study the asymptotic behavior of an infection age structured SIR epidemic model with spatial diffusion in the case of Neumann boundary condition. By using the method of characteristics, we transform the model into a system of a reaction-diffusion equation and an integral equation of Volterra type. We then define the basic reproduction number R_0 and show that if $R_0 < 1$, then the disease-free steady state is globally attractive, whereas if $R_0 > 1$, then the disease is persistent. Moreover, under an additional assumption that the maximum age of infectiousness is finite, we show that if $R_0 > 1$, then the constant endemic steady state is globally attractive.

31 Takeshi Gotoda (Hokkaido Univ.)
Masaaki Uesaka (Hokkaido Univ.)
Yusuke Yasugahira (Hokkaido Univ.)
Yasuaki Kobayashi (Univ. of Tokyo)
Hiroyuki Kitahata (Chiba Univ.)
Mitsuhiro Denda (Shiseido Co., Ltd.)
Masaharu Nagayama (Hokkaido Univ.)
Mathematical modeling for layered structure and barrier function of the epidermis 15

Summary: One of the most important functions of the epidermis is the functional barrier. In this study, we focus on two barrier functions: one is the stratum corneum (SC) that consists of cornified cells and inter-cellular lipids, and the other is the tight junctions (TJs) appearing in the stratum granulosum (SG). The mechanism of the occurrence and maintenance of TJs remains unexplained. Using a mathematical model of the epidermis, we propose a mechanism of the stable formation of TJs. We also evaluate the barrier function in the SC with a mathematical modeling for epidermal desquamation.

32 Maya Kageyama (Kwansei Gakuin Univ.)
Atsushi Yagi (Osaka Univ.*)
Segregation patterns for self-regulating homeostasis model 15

Summary: Vegetation patterns and its environmental conditions have a close relationship. The Daisyworld model which is one of the conceptual earth system model introduced by Watson and Lovelock in 1983 may give us new viewpoints about the relationship. In this talk, we consider two-dimensional Daisyworld model to which is extended one-dimensional one of Adams, Carr, Lenton and White in 2003. In our model, the white and black daisies form the three principal types of segregation patterns depending on the intensity of solar luminosity. The purpose of this talk is to discuss in terms of mathematics and biologic that Turing's mechanisms are inherent in these pattern formations.

33 Sohei Tasaki (RIKEN/Sendai Nat. Coll. of Tech.)
Madoka Nakayama (Sendai Nat. Coll. of Tech.)
Izumi Takagi (Tohoku Univ./Renmin Univ. of China)
Wataru Shoji (Tohoku Univ./Tohoku Univ.)
Necessary and sufficient condition for hysteresis in a mathematical model of cell type regulation of *Bacillus subtilis* 15

Summary: *Bacillus subtilis* uses different cell types to suit environmental conditions and cell density. The subpopulation of each cell type exhibits various environment-sensitive properties. Furthermore, division of labor among the subpopulations results in flexible development for the community as a whole. Here we present a simple mathematical model of cell type regulation of *B. subtilis*. We report a necessary and sufficient condition for hysteresis of cell type selection in the model, and discuss how the cell state dynamics is controlled in response to environmental variation.

13:15–14:15 Talk Invited by Applied Mathematics Section

Shingo Iwami (Kyushu Univ.) Collaboration between mathematical sciences and virology

Summary: Current studies of viral replication deliver detailed time courses of several virological variables, like the amount of virus and the number of target cells, measured over several days of the experiment. Each of these time points provides a snapshot of the virus infection kinetics and is brought about by the complex interplay of target cell infection, viral production and death. It remains a challenge to interpret this data quantitatively and reveal the kinetics of these underlying processes to understand how the viral infection depends on these kinetic properties. In order to decompose the kinetics of virus infection, I introduce a method to "quantitatively" describe the virus infection, and discuss the potential of the combinational analyses with experimental and computational virology.

March 19th (Tue) Conference Room I

9:20–11:45

34 Shohei Satake (Kobe Univ.) On the Erdős–Moon problem ····· 15

Summary: A tournament T is an orientation of a complete graph. Here we consider tournaments with vertices labelled by $\{1, 2, \ldots\}$. For a permutation π on vertices, an arc (x, y) of T is called *consistent* if x precedes y in π. Erdős–Moon (1965) mentioned the problem finding explicit constructions of tournaments with a small number of consistent arcs. Alon–Spencer (2000) found that Paley tournaments are such tournaments. In this talk, we give many such explicit tournaments of more flexible orders. Our method is based on a digraph-version of the expander-mixing lemma found by Vu (2008). Moreover our discussion provides a wide generalization of Alon–Spencer's proof.

35 Sho Suda (Aichi Univ. of Edu.)
Alexander Gavrilyuk (Pusan Nat. Univ.)
Janoš Vidali (Univ. of Ljubljana)
On tight 4-designs in Hamming association schemes ····· 10

Summary: We use triple intersection numbers of association schemes to show non-existence of tight 4-designs in Hamming association schemes $H(n, 6)$. Combining with a result by Noda (1979), this completes the classification of tight 4-designs in $H(n, q)$.

36 Kosuke Suzuki (Hiroshima Univ.)[b] Classification of digital (0,2)-sequences in base 2 ····· 15

Summary: We give a classification of all matrices $C_1, C_2 \in \mathbb{F}_2^{\mathbb{N}\times\mathbb{N}}$ which generate a digital $(0, 2)$-sequence in base 2. This gives us an implication for Markov-chain quasi Monte-Carlo point sets.

37 Hiroshi Naruse (Univ. of Yamanashi)
Soichi Okada (Nagoya Univ.)
Generating function of reverse plane partitions and equivariant K-theory ····· 15

Summary: In this talk we will give a generalization of the hook formula for the generating function of reverse plane partitions on d-complete posets to skew d-complete posets using Schubert calculus of equivariant K-theory. This gives an alternative uniform proof for the d-complete posets.

38 Hidefumi Ohsugi (Kwansei Gakuin Univ.)
Akiyoshi Tsuchiya (Osaka Univ.)
Reflexive polytopes arising from bipartite graphs with γ-positivity associated to interior polynomials ····· 15

Summary: In this talk, we introduce reflexive polytopes $\mathcal{B}_G$ arising from bipartitle graphs G, and discuss their δ-polynomials. Since $\mathcal{B}_G$ has a regular unimodular triangulation, its δ-polynomial is palindromic and unimodal. We show stronger properties for the δ-polynomial of $\mathcal{B}_G$. In fact, δ-polynomial of $\mathcal{B}_G$ is γ-positive and its γ-polynomial is given by an interior polynomial (a version of Tutte polynomial of a hypergraph). Moreover, the δ-polynomial is real-rooted if and only if the corresponding interior polynomial is real-rooted.

39 Ayaka Ishikawa (Yokohama Nat. Univ.) The enumeration of unlabeled rooted trees using Young tableaux ····· 15

Summary: Most of the tree enumeration formulas are generating functions or recurrence formulas. In this talk, we show the explicit formula for the number of unlabeled rooted trees with a certain condition. The formula is described in terms of Young tableaux.

40 Akiko Yazawa (Shinshu Univ.) The Hessian of the generating function for the forests with k components ····· 15

Summary: Let us consider the forests with k components in the complete graph. We define Φ to be the weighted generating function for them. We calculate the eigenvalues of the Hessian matrix of Φ to show that the Hessian of Φ does not vanish.

41 Chie Nara (Meiji Univ.)
Jin-ichi Itoh (Sugiyama Jogakuen Univ.)
Continuous flattening of the 2-dimensional skeleton in a regular simplex 15

Summary: It is known that we can continuously flatten the surface of a regular tetrahedron onto any of its faces by moving creases to change the shapes of some faces successively. Let P_n be an n-dimensional regular simplex with $n \geq 4$, and S be the set of its 2-dimensional faces, in other words, the 2-dimensional skeleton of the triangular faces in P_n. We show that S can be continuously flattened onto any face F of S such that at least two thirds of the edges and two ninths of the triangular faces are rigid during the motion.

42 Iwao Sato (Oyama Nat. Coll. of Tech.)
Hideo Mitsuhashi (Hosei Univ.)
Hideaki Morita (Muroran Inst. of Tech.)
The weighted Kirchhoff index of a graph 15

Summary: We consider the weighted Kirchhoff index of a graph G, and present a generalization of Somodi's Theorem on one of the Kirchhoff index of a graph. Furthermore, we give an explicit formula for the weighted Kirchhoff index of a regular covering of G in terms of that of G.

14:20–16:30

43 Masahiro Hachimori (Univ. of Tsukuba)
An optimization problem on the orientations of graphs related to the out-degrees 10

Summary: For a given graph, we consider an optimization problem in which we explore an orientation that minimize an objective function whose value is determined by the out-degrees of the vertices under the orientation. When the orientation is restricted to acyclic ones, such a problem is related to the recognition of shellability of simplicial complexes, so the optimization problem is considered to be hard. In this talk we show that, without acyclicity constraint, the optimization problem under consideration can be solved in polynomial time. This result indicates that the hardness of shellability recognition is caused by the acyclicity.

44 Kiyoshi Ando (Nat. Inst. of Information / JST ERATO)
Some local conditions for k-contractible edges 15

Summary: An edge of k-connected graph is said to be k-contractible if the contraction of it results in a k-connected graph. A condition on the subgraph induced by the neighborhood of each vertex of a k-connected graph said to be a local condition of the graph. We present three local conditions for a k-connected graph to have a k-contractible edge.

45 Shinya Fujita (Yokohama City Univ.)
On the optimal proper connection number in connected graphs 10

Summary: Some recent results on the optimal proper connection number in connected graphs will be reviewed.

46 Akira Saito (Nihon Univ.)
Jun Fujisawa (Keio Univ.)
Robert E. L. Aldred (Otago Univ.)
Distance matching extension of star-free graphs 15

Summary: A matching M in a graph G is extendable if there exists a perfect of G containing M. Also, M is a distance d matching if the distance of every pair of distinct edges in M is at least d. A graph G is distance d matchable if every distance d matching in G is extendable, regardless of its size. In this talk, we discuss the distance d matchability of star-free graphs. In particular, we report that for every integer $k \geq 3$, there exists an integer d such that every locally $(k-1)$-connected $K_{1,k}$-free graph of even order is distance d matchable.

47 Jun Fujisawa (Keio Univ.) Separating triangles in non-hamiltonian 1-tough triangulations ····· 15
Carol T. Zamfirescu (Ghent Univ.)

Summary: In this talk, we consider triangulations of the plane. Ozeki and Zamfirescu asked whether there are non-hamiltonian 1-tough triangulations in which every two separating triangles are disjoint. We answer this question in the affirmative by proving that there are infinitely many non-hamiltonian 1-tough triangulations with pairwise disjoint separating triangles.

48 Yusuke Suzuki (Niigata Univ.) Partially broken orientations of Eulerian plane graphs ····· 15
Gen Kawatani (Tokyo Univ. of Sci.)

Summary: It is well-known that any Eulerian plane graph G is face 2-colorable and admits an orientation, which is an assignment of a direction to each edge of G, such that incoming edges and outgoing edges appear alternately around any $v \in V(G)$; we say that such a vertex v has the *alternate property*, and that such an orientation is *good*. In this talk, we discuss orientations given to Eulerian plane graphs such that some specified vertices do not have the alternate property, and give a characterization in terms of the *radial graph* of the graph. Furthermore, for a given properly drawn graph on the plane (with crossing points), we discuss whether it has a good orientation or not.

49 Kengo Enami (Yokohama Nat. Univ.) Non-isomorphic graphs with the same beans function ····· 15

Summary: The beans function $B_G(x)$ of a connected graph G is defined as the maximum number of points on G such that any pair of points have distance at least $x > 0$. We give a method of constructing non-isomorphic graphs with the same beans function.

50 Yumiko Ohno (Yokohama Nat. Univ.) An algorithm for enumerating triad colorings of triangulations on closed surfaces ····· 15

Summary: A *triangulation* on a closed surface is a graph embedded on the surface such that every face is bounded by a cycle of length 3. Let G be a triangulation on a closed surface and $n \geq 3$ be a natural number. A coloring $c : V(G) \to \mathbb{Z}_n$ is called an *n-triad coloring* if $\{c(u), c(v), c(w)\}$ belongs to $\{\{i, i+1, i+2\} \mid i \in \mathbb{Z}_n\}$ for any face uvw of G.
We would like to determine the set of integers n such that G has n-triad colorings. In this talk, to determine such a set completely, we shall introduce an algorithm for enumerating triad colorings of a given triangulation G by using perfect matchings of a dual of G.

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

Michitaka Furuya (Kitasato Univ.)♭ Comparison and characterization of graph classes generated by forbidden subgraph conditions

Summary: When we consider some properties for graphs, forbidden subgraph conditions are frequently used as essential (sufficient) conditions. For example, Duffus, Gould and Jacobson (1981) proved that every 2-connected $\{K_{1,3}, N\}$-free graph has a Hamiltonian cycle, and Bedrossian (1991) proved that every 2-connected $\{K_{1,3}, B_{1,2}\}$-free graph has a Hamiltonian cycle, where $K_{1,3}$ is the star with three leaves, N is the graph with degree sequence $(3, 3, 3, 1, 1, 1)$ and $B_{1,2}$ is the graph with degree sequence $(3, 3, 2, 2, 1, 1)$ having a triangle. Although above two results were independently given, their forbidden subgraph conditions seem to be similar. Indeed, the speaker and Shoichi Tsuchiya explicitly characterized the connected $\{K_{1,3}, B_{1,2}\}$-free but not N-free graphs. Such a characterization, together with Duffus–Gould–Jacobson theorem, leads to Bedrossian's theorem as a corollary. Thus in forbidden subgraph problem, it is important to discuss about the difference of classes of graphs generated by forbidden subgraph conditions. In this talk, we survey recent progress from this point of view. We also focus on forbidden sugraph conditions generating a finite set of high-connected graphs.

March 20th (Wed) Conference Room I

9:20–11:50

51 Akihiro Narimatsu (Yokohama Nat. Univ.) Conditions for existence of localization in space-homogeneos quantum walks on Z^d 15

Summary: Localization and ballistic spreading are characteristic properties of quantum walks with contrast to random walks. We consider mainly localization of space-homogeneous discrete time quantum walks on the d-dimensional lattice. A necessary and sufficient condition of localization was presented by Tate in 2014. The stationary measure of the Grover walk on the d-dimensional lattice was given by Komatsu and Konno in 2017. Here we obtain a necessary and sufficient condition of localization via the stationary measure. Moreover, we get a proof of non-existence of localization of the Fourier walk on the d-dimensional lattice with $2 \leq d \leq 5$ by using our result.

52 Kei Saito (Yokohama Nat. Univ.) Periodicity for the Fourier quantum walk on graphs 10

Summary: Quantum walks determined by the coin operator on graphs have been intensively studied. The typical examples of coin operator are the Grover and Fourier matrices. The periodicity of the Grover walk is well investigated. However, the corresponding result on the Fourier walk is not known. In this talk, we consider the Fourier walk on graphs whose degree of vertex is power of a prime number. Then, we present a necessary condition for the construction of graphs to have the finite period. As an application of our result, we show that the Fourier walks do not have any finite period for some classes of graphs such as Hamming graphs including hyper cubes, and Wheel graphs.

53 Kei Saito (Yokohama Nat. Univ.), Akito Suzuki (Shinshu Univ.), Akihiro Narimatsu (Yokohama Nat. Univ.), Toru Fuda (Kokushikan Univ.) Long-time behavior of the split-step quantum walk on cycles 10

Summary: Quantum walks are quantum mechanical counterparts of random walks and promising platforms expected to realize topological phenomena. Here we consider two-phase split-step quantum walks on cycles defined by Balu et al., which have two different coins across the boundary of two regions. In this talk, we analyze the long-time behavior of the split-step quantum walk by using a spectral mapping theorem.

54 Shunsuke Kanatani (Yokohama Nat. Univ.), Takashi Komatsu (Yokohama Nat. Univ.), Norio Konno (Yokohama Nat. Univ.) Orthogonal polynomials induced by two-dimensional quantum walk 10

Summary: The orthogonal polynomial is the set of polynomials determined by weight functions. In our study, we take limit density functions of the weak limit theorem for quantum walk on the two-dimensional lattice as a weight function which determines orthogonal polynomial of two variables. Here, we construct the orthogonal polynomial by using the Gram–Schmidt orthonormalization with a monomial order, and also get the three-term relation which is an important property of orthogonal polynomial. Moreover, we present limit density function with one parameter by projecting a two-dimensional quantum walk to one dimension. In order to investigate the orthogonal polynomial of two variables, we consider an orthogonal polynomial determined by these limit density functions.

Summary: Quantum walks are regarded as quantum versions of random walks and are applied to several study fields. The time evolution of the quantum walks is defined by a unitary process. Due to the unitarity, the behavior of quantum walks is quite different from that of random walks. Recently, as a special example of such a difference, periodicity of quantum walks is studied. Our ultimate aim is to characterize spatial structure which yield periodic quantum walks. In particular, such characterization for the Grover walks on graphs is intensively analyzed by using a spectral mapping theorem. In this talk, we provide some necessary conditions of graphs to give an odd-periodic Grover walk through dynamical analysis.

Summary: The t-tessellation of graph $G = (V, E)$ is a sequence of t-kinds of clique decompositions so that all the edges of $E(G)$ are covered by these decompositions. We introduce a directed graph from some abelian covering graphs so that the indegree and outdegree are the same for every vertex. Since this deformation reduces the degree of each vertex, we can save the dimension of the local coin assigned at each vertex of the quantum walk. This reduction is expected to make it possible for some experimental implementations of quantum walks on graphs, in particular, in the case of degree 2. In this talk, we show a connection between the directed graph and t-tessellation, and give some examples of asymptotic behavior of quantum walks on directed graphs.

Summary: In this talk, we give general expression of the solutions of the eigenvalue problem, and discuss the stationary measure mainly for three-state quantum walk (QW) by using our new recipe. So far, two kinds of limit theorems have described the characteristic properties of QWs mathematically. The one is the limit theorem, which is composed of the time-averaged limit measure, corresponding to localization. The other is the weak convergence theorem, which expresses the ballistic spreading of the walker by the weak limit measure. In recent years, stationary measure for QW has received attention as another key measure for the asymptotic distribution of QW. The stationary measure provides the stationary distribution, for instance. Firstly, we propose a new type of theorems to construct the stationary measure by using transfer matrices, and then, we show some concrete examples comparing the results with that obtained by other methods we had developed. One of the interesting and crucial future problems is to make clear the whole picture of the set of stationary measures.

Summary: In this talk, we deal with the period T_N of the quantum walk with moving shift and flip-flop shift on a cycle C_N with N vertices. Konno et al. in 2017 showed that $T_2 = 2, T_4 = 8, T_8 = 24$ and $T_N = \infty$ if $N \neq 2, 4, 8$ for the two-state Hadamard walk with moving shift on C_N by using the path counting and cyclotomic polynomials. Here we proved that $T_N = \infty$ if $N \neq 3$ for the three-state Grover walk and Fourier walk with moving shift and flip-flop shift on C_N by using the ring of integers of the cyclotomic fields and the property of eigenvalues for unitary matrix which determines the evolution of the walk.

Summary: We consider one-dimensional two state quantum walks. We derive a weak limit theorem for a class of long range type quantum walks.

Summary: In this talk, we consider a quantum walk whose time evolution is given by $U = SC$, where S and C are self-adjoint and S is unitary on an abstract Hilbert space. We emphasize that U is not always unitary. In the case that U is unitary, the spectral mapping theorem of quantum walk is provided by Y. Higuchi, E. Segawa and A. Suzuki. By the way, K. Mochizuki, D. Kim and H. Obuse introduce a new model of quantum walk, derived from recent experiment, whose time evolution is not unitary. This model is a concrete example of our model. We provide a spectral mapping theorem for the part of all eigenvalues of U.

Topology

March 17th (Sun) Conference Room VII

9:45–12:00

1 Naoki Kitazawa (Kyushu Univ.) Explicit fold maps and their source manifolds · 15

Summary: In this talk, as a fundamental and important problem on the theory of Morse functions and their higher dimensional versions including fold maps, which are simplest generalizations of Morse functions, and application to differential topology of manifolds, we introduce history, known results, and new results on manifolds admitting explicit fold maps.

2 Naoki Kitazawa (Kyushu Univ.) Inverse images of regular values of a differentiable map and the toplogy of its Reeb space · 15

Summary: In geometric theory of Morse functions, fold maps, which are higher dimensional versions of Morse functions, and more general good smooth maps and its application to geometry of manifolds, Reeb spaces between smooth maps are fundamental and important. They are defined as the spaces of all connected components of inverse images and in cosiderable cases, they are polyhedra of dimensions equal to those of the target spaces and have much information of homology groups etc.. Related to this branch, the top dimensional homology groups of Reeb spaces are shown to be non-trivial if there exists an inverse image of a regular value containing a manifold being not null-cobordant in 2012–14 by Hiratuka and Saeki. In this talk, an extension of this fact and explicit application will be presented.

3 Takahiro Yamamoto (Tokyo Gakugei Univ.) Topological equivalence among map germs of 3-manifolds with boundary into the plane · 15

Summary: Let $(X^n, 0)$ be the germ at $0 \in \mathbb{R}^n$ of the pair $(\mathbb{R}^n, \mathbb{R}^{n-1} \times \{0\})$. We shall use $(x_1, \ldots, x_{n-1}, y)$ coordinates on $\mathbb{R}^n$. The boundary and interior of our manifold with boundary correspond to the part of $y > 0$ and $y > 0$ respectively. In this talk, we introduce the notions *topologically* $\mathcal{B}$*-equivalent* and *topologically* $\mathcal{B}_+$*-equivalent* among smooth map germs $(X^n, 0) \to (\mathbb{R}^2, 0)$. Then, we show that there are three invariants of topologically $\mathcal{B}_+$-equivalent (or three invariants of topologically $\mathcal{B}$-equivalent) among smooth map germs $(X^3, 0) \to (\mathbb{R}^2, 0)$.

4 Kenta Hayano (Keio Univ.) Stability of non-proper functions · 15

Summary: In this talk, we will give a sufficient condition for (strong) stability of non-proper smooth functions (with respect to the Whitney C^∞-topology). We introduce the notion of end-triviality of smooth mappings, which concerns behavior of mappings around the ends of the source manifolds, and show that a Morse function is stable if it is end-trivial at any point in its discriminant. We further show that a Morse function $f : N \to \mathbb{R}$ is strongly stable (i.e. there exists a continuous mapping $g \mapsto (\Phi_g, \phi_g) \in \mathrm{Diff}(N) \times \mathrm{Diff}(\mathbb{R})$ such that $\phi_g \circ g \circ \Phi_g = f$ for any g close to f) if (and only if) f is quasi-proper.

5 Yutaro Kabata (Kyushu Univ.), Kentaro Saji (Kobe Univ.), Masaru Hasegawa (Iwate Med. Univ.) Contact cylindrical surfaces and apparent contours around parabolic points of regular surfaces in Euclidean 3-space · 15

Summary: The apparent contour of a smooth surface is considered as the set of the singularities of a projection mapping of the surface, and we can investigate it in terms of singularity theory. What information of a surface can we get from the apparent contour, especially when the apparent contour is singular? In this talk, we give some answers to the question considering the contact types of surfaces with smooth cylindrical surfaces.

6 Kentaro Saji (Kobe Univ.)
Yoshiki Yamamoto (Kobe Univ.)
Contacts of standard cuspidal edge with singular surfaces ····· 10

Summary: There are many studies about curves, surfaces and curves, surfaces with singular points by using height functions and distance squared functions. Height functions represents the contact with the plane, and distance squared functions do with the round sphere. These method works well for surfaces with singular points, for such cases, studying contact with singular objects also must work well. In this talk, we present an attempt studying contacts of singular surfaces with the standard cuspidal edge.

7 Keisuke Teramoto (Kobe Univ.) Functions on causpidal edges and D_4 singularities ····· 15

Summary: Cuspidal edges are fundamental singularities of wave fronts. A surface with cuspidal edge singularities has a well-defined unit normal vector or the Gauss map even at cuspidal edges. Thus we can consider the extended distance squared function and the extended height function on cuspidal edges. In this talk, we give conditions that D_4 singularities appear on the extended distance squared and the extended height functions on cuspidal edges by geometric invariants of cuspidal edges. Moreover, we show relations among singularities of parallel surfaces, singularities of Gauss maps and conditions of D_4 singularities appearing on such surfaces.

8 Takahiro Matsuyuki (Tokyo Tech) Obstruction class of a deformation of homotopy algebra models ····· 15

Summary: We define the associated simplicial bundle of homotopy algebra models of fibers for a fiber bundle. The obstruction theory of simplicial bundles yields the obstruction class of the simplicial bundle. A characteristic class of a fiber bundle is obtained for each invariant anti-symmetric form on the homotopy group of a fiber of the simplicial bundle. For a surface bundle, this class is equivalent to twisted Morita–Mumford classes for the bundle. Thus, the characteristic classes include Morita–Mumford classes of a surface bundle. For another example, we can also obtain the Euler class of a specific sphere bundle by direct calculus.

14:15–15:05

9 Masaki Nakagawa (Okayama Univ.)
Hiroshi Naruse (Univ. of Yamanashi)
Darondeau–Pragacz formulas in complex cobordism ····· 15

Summary: We generalize the Gysin formulas for flag bundles in the ordinary cohomology theory, which are due to Darondeau–Pragacz, to the complex cobordism theory.

10 Shun Wakatsuki (Univ. of Tokyo) Generalizations of the loop coproduct ····· 15

Summary: We will give two generalizations of the loop coproduct to the mapping spaces $Map(S^k, M)$ from k-dimensional spheres. One generalization is defined when M is a k-connected space with finite dimensional rational homotopy group. This is based on the finiteness of the dimension of the $(k-1)$-fold based loop space of M as a Gorenstein space. The other generalization is defined when M is a 1-connected Poincaré duality space. It is different from the previous generalization and is easier to compute. Moreover, it has an application to the TNCZ problem of fibrations, which is originally due to Menichi in the case of the loop coproduct.

11 Shin Hayashi (Nat. Inst. of Adv. Industrial Sci. and Tech./Tohoku Univ.)
Index theory for Toeplitz operators associated with some concave corners and its applications ····· 10

Summary: When we consider the square lattice $\mathbb{Z}^2$ and half-planes of it distinguished by lines through the origin, $y = \alpha x$ and $y = \beta x$, a quarter plane appears as an intersection of two half-planes. Associated with this quarter-plane, we can consider quarter-plane Toeplitz operators. Its index theory is applied to the study of topologically protected corner states, which are also studied in condensed matter physics under the name of higher-order topological insulators. In this talk, we consider Toeplitz operators, associated with the sum of two half-planes and study its index theory. We further discuss its implications for the study of topologically protected corner states.

15:20–16:20 Talk Invited by Topology Section

Kiyonori Gomi (Shinshu Univ.) Introduction to topological insulators for topologists

Summary: Topological insulators are certain quantum states of matters which are experimentally observed as materials with insulating bulk and metallic edge. Topological K-theory is applied in Kitaev's theoretical classification of topological insulators. This idea is generalized to the classification of topological crystalline insulators, and prompted calculations of twisted equivariant K-theory. An outcome of such calculations in my collaborating work with Ken Shiozaki and Masatoshi Sato suggests a torsion phase of topological insulators protected by glide symmetry. As an introduction to topological insulators for topologists, my talk will be an exposition of these K-theoretic classifications. If time permits, I would like to mention recent applications of equivariant generalized (co)homology theory to the classification of crystalline symmetry protected phases.

March 18th (Mon) Conference Room VII

9:30–11:50

12 Atsuhide Mori (Osaka Dental Univ.) A pair of Poisson structures associated with normal distributions · · · · 15

Summary: The speaker constructed a pair of symplectic structures on the product of two copies of the space of univariate normal distributions and explained the relation between the relevant information geometry and Bayesian learning. We generalize this to the multivariate case by constructing a pair of Poisson structures on the similar product.

13 Kazuaki Ogiwara (Osaka City Univ.) The smooth torus orbit closures in the Grassmannians · · · · · · · · · · · · · 15
Masashi Noji (Osaka City Univ.)

Summary: It is known that for the natural algebraic torus actions on the Grassmannians, the closures of torus orbits are toric varieties, and that these toric varieties are smooth if and only if the corresponding matroid polytopes are simple. We shall report that simple matroid polytopes are products of simplices and smooth torus orbit closures in the Grassmannians are products of complex projective spaces. Moreover, it turns out that the smooth torus orbit closures are uniquely determined by the corresponding simple matroid polytopes.

14 Yuuki Shimizu (Kyoto Univ.) Fluid dynamics on surfaces from the viewpoint of the singular Riemannian foliation generated by a Killing vector field · · · · · · · · · · · · · · · · · · 15

Summary: We carry out theoretical analysis of fluid dynamics on surfaces assuming the existence of a non-normal and nontrivial Killing vector field. To this end, we derive an exact solution of the hydrodynamic Green's function using the homogeneous foliation generated by the Killing vector field. After that we discuss physical properties of the Killing vector field and potential vector field as a steady solution of the Euler equations.

15 Tsukasa Ishibashi (Univ. of Tokyo) Cluster realization of Weyl groups and higher Teichmüller theory · · · · 15
Rei Inoue (Chiba Univ.)
Hironori Oya (Shibaura Inst. of Tech.)

Summary: For a symmetrizable Kac–Moody Lie algebra $\mathfrak{g}$, we construct a family of weighted quivers $Q_m(\mathfrak{g})$ and realize the Weyl group as a subgroup of the corresponding cluster modular group. This is a generalization of the construction for type A_n and $\tilde{A}_n$ given by Inoue–Lam–Pylyavskyy. Moreover if $\mathfrak{g}$ is of finite type and m is the Coxeter number, then our quiver encodes the cluster structure of the moduli space of decorated G-local systems on the punctured disk with two marked points on its boundary. Using this we define an action of the Weyl group on the moduli space, and show that this action coincides with the one given by Goncharov–Shen.

16 Wataru Yuasa (Kyoto Univ.) On power subgroups of Dehn twists in hyperelliptic mapping class groups · · · · · 15

Summary: We discuss indices of power subgroups in the mapping class group of a punctured sphere and in the hyperelliptic mapping class group of an oriented closed surface. The main tool we use is a projective representation of the mapping class group obtained through the linear skein theory. We show that power subgroups of symmetric Dehn twists have infinite indices in hyperelliptic mapping class group in many cases. Our works are the study of "the remaining case" of Masbaum's work and a generalization of Stylianakis' work.

17 Takuya Katayama (Hiroshima Univ.), Erika Kuno (Osaka Univ.) On virtual embeddability between the mapping class groups of some surfaces · · · · · 15

Summary: As is well-known, by the Birman–Hilden theory, the mapping class group of a sphere with p marked points is virtually embedded in the mapping class group of a closed surface of genus g if p is not greater than $2g+2$. Here, we say that a group H is virtually embedded in a group G if H has a finite index subgroup which can be embedded in G. In this talk, using the curve graphs of surfaces and right-angled Artin groups in the mapping class groups, we prove that no finite index subgroup of the mapping class group of a sphere with at least $2g+3$ marked points is embedded in the mapping class group of a closed surface of genus g.

18 Yoshihiro Asayama (Yokohama Nat. Univ.), Naoki Matsumoto (Seikei Univ.) Balancedness for spanning bipartite quadrangulations of triangulations · · · · · 15

Summary: A *triangulation* (resp., *quadrangulation*) on a surface $\mathbb{F}$ is a map with each face bounded by a cycle of length 3 (resp., 4). It is known that every triangulation on $\mathbb{F}$ has a quadrangulation as a spanning subgraph. For the spherical case, every quadrangulation is bipartite. On the other hand, there are both bipartite and nonbipartite ones on non-spherical surfaces. Kündgen and Thomassen asked whether the bipartiteness of a spanning quadrangulation of a given triangulation on $\mathbb{F}$ can be controlled. We focus on the balancedness for spanning bipartite quadrangulations of a given triangulation when G has a spanning bipartite quadrangualation. In this talk we will give an evaluation for the balancedness. This is a joint work with Naoki Matsumoto (Seikei University).

19 Takamichi Sushida (Hokkaido Univ.), Yoshikazu Yamagishi (Ryukoku Univ.) Voronoi tilings with general Archimedean spiral lattices · · · · · 15

Summary: We study Voronoi tilings with general Archimedean spiral lattices related to phyllotactic patterns of typical plants such as sunflower. In this talk, we show that Voronoi tilings with the general Archimedean spiral lattices possesses annular patterns (the grain boundaries) which consist of heptagons, hexagons, and pentagons. Moreover, we show that the number of polygons in grain boundaries is represented by denominators of convergents of the divergence angle. Also, we consider the limit shapes of Voronoi polygons in grain boundaries. If the divergence angle is an irrational number, the limit shape is are rectangles. In particular, if the divergence angle is an irrational number which is equivalent to the golden section, the limit shape is the square.

March 18th (Mon) Conference Room V

13:00–13:10 Presentation Ceremony for the 2018 MSJ Geometry Prize

13:15–14:15 Award Lecture for the 2018 MSJ Geometry Prize

Yuji Odaka (Kyoto Univ.)* Collapsing Kähler–Einstein metrics and moduli compactification

Summary: It is known that any compact Riemann surface admits a unique constant Gaussian curvature (Hermitian) metrics. Extending it to higher dimensional complex varieties, there is a notion of Kähler–Einstein metrics which is canonical (unique), characterized by constancy of Ricci curvature. The sign of Ricci curvature crucially controls the geometric properties, especially when we take limit spaces.
In our studies done while ago, we worked on relations between such metrics and birational algebraic geometry, and then algebra-geometric compactification of moduli space of Fano varieties, positive Ricci curvature case. The focus of this talk will be, among others, on the case Ricci curvature is zero, so-called "Calabi–Yau metrics" or Ricci-flat Kähler metrics. Our recent work with Yoshiki Oshima (arXiv:1810.07685) provides a moduli-theoretic framework for the collapsing of Ricci-flat Kähler metrics by certain explicit compactifications of classical moduli varieties. The speaker originally called the obtained compactification "tropical geometric compactification" and the joint work largely develops the theory.
On the way, what we observe in various forms repeatedly are two general deep natures of Kähler–Einstein metrics, its "algebraicity" (or "algebro-geometricity") and "minimality".

March 19th (Tue) Conference Room VII

9:00–11:50

20 Yuta Nozaki (Univ. of Tokyo) An infinite family of homologically fibered knots of the same genus 15

Summary: In this talk, we prove that if a rational homology 3-sphere X contains a homologically fibered knot of genus g, then X contains infinitely many such knots. The proof is based on the simplicial volume of 3-manifolds whose boundaries consist of tori. Combining this result with our previous work, we conclude that every lens space contains infinitely many homologically fibered knots of genus one.

21 Kazuhiro Ichihara (Nihon Univ.), Makoto Ozawa (Komazawa Univ.), J. Hyam Rubinstein (Univ. of Melbourne) Decomposing Heegaard splittings along separating incompressible surfaces in 3-manifolds 10

Summary: In this talk, we report on our results on separating incompressible surfaces and incompressible subsurfaces of Heegaard surfaces in a 3-manifold.

22 Toru Ikeda (Kindai Univ.) Surgery descriptions of orientation-reversing periodic maps on closed orientable 3-manifolds 10

Summary: We study the problem of whether or not a symmetry of a compact orientable 3-manifold given by an orientation-reversing periodic diffeomorphism can be reflected on a corresponding framed link, called a surgery description.

23 Shunsuke Tsuji (Kyoto Univ.) A construction of the universal $sl(n)$-quantum invariant for integral homology 3-spheres 15

Summary: Using a completed HOMFLY-PT skein algebra and Heegaard splittings, we construct the universal $sl(n)$ quantum invariant for integral homology 3-spheres.

Summary: Shimizu introduced a region crossing change unknotting operation for knot diagrams. As extensions, two integral region choice problems are proposed and the existences of solutions of the problems are shown for all non-trivial knot diagrams by Ahara and Suzuki, and Harada. We relate both integral region choice problems with an Alexander index for regions of a link diagram, and discuss the problems on link diagrams.

Summary: We give a computation of finite type invariants of spherical curves by the aid of computers, and compare it with the dimension of Vassiliev invariants of knots.

Summary: We determine the set of alternating knots with the crosscap number two.

Summary: Goussarov, Polyak, and Viro conjectured that every finite type invariant of classical knots could be extended to a finite type invariant of long virtual knots (Goussarov–Polyak–Viro Conjecture). For the degree-three case of the conjecture, we give an answer with a new viewpoint by introducing a reduced Polyak algebra for classical knots.

Summary: In this talk, in order to define an augmented Alexander matrix for a handlebody-link, we define an extension of a multiple conjugation quandle and introduce an MCQ Alexander pair which gives a linear extension of a multiple conjugation quandle.

Summary: Given a shadow biquandle (B, X) composed of a biquandle B and a strongly connected B-set X, we have a local biquandle structure on X. The (co)homology groups of such shadow biquandles are isomorphic to those of the corresponding local biquandles. Moreover, cocycle invariants, of oriented links and oriented surface-links, using such shadow biquandles coincide with those using the corresponding local biquandles. The results imply that for some cases, the Niebrzydowski's theory related to knot-theoretic ternary quasigroup is the same as shadow biquandle theory.

Summary: We define a Fox derivative for quandles and construct an invariant of quandles. In particular, by taking knot quandles, we obtain an invariant of pairs of knots and quandle representations.

Summary: A G-cork (reps. a weakly equivariant G-cork) is a pair (C, G) of a compact contractible 4-manifold C and a subgroup G of the diffeomorphism group (resp. the mapping class group) of ∂C such that any nontrivial element of G does not extend over C. In this talk, we will explain how to construct a G-cork for any extension G of $\mathbb{Z}^m$ by a finite subgroup of $\mathrm{SO}(4)$ and a weakly equivariant G-cork for any extension G of $\mathbb{Z}^m$ by a finite solvable group.

14:15–15:05

32 Airi Aso (Tokyo Metro. Univ.) Twisted Alexander polynomials of tunnel number one Montesinos knots 10

Summary: In this talk, we compute the twisted Alexander polynomials of tunnel number one Montesinos knots associated to their $SL_2(\mathbb{C})$ representations. We give presentations of the knot groups which has two generators and one relation. We will also give the holonomy representations.

33 Ryoto Tange (Kyushu Univ.) Twisted Alexander polynomials and certain Dehn surgeries on twist knots 10

Summary: We study some properties on twisted Alexander polynomials of twist knots for non-abelian $\mathrm{SL}_2(\mathbb{C})$-representaions and discuss some relations with certain Dehn surgeries.

34 Taizo Kanenobu (Osaka City Univ.) Toshio Sumi (Kyushu Univ.) Twisted Alexadner polynomial of a ribbon 2-knot 10

Summary: The twisted Alexander polynomial is defined as a rational function, not necessarily a polynomial. It is shown that for a ribbon 2-knot, the twisted Alexander polynomial associated to a irreducible representation of the knot group to SL(2, F) is always a polynomial. Also, if a ribbon 2-knot of 1-fusion is fibered then its twisted Alexander is monic.

35 Tomoyuki Yasuda * (Nara Nat. Coll. of Tech.) Evaluations of the ribbon crossing number on ribon 2-knots and the crossing number on 1-knots. 10

Summary: A 2-knot is a surface in $\mathbf{R^4}$ that is homeomorphic to $\mathbf{S^2}$, the standard sphere in 3-space. A ribbon 2-knot is a 2-knot obtained from m 2-spheres in $\mathbf{R^4}$ by connecting them with $m-1$ annuli. Let $\mathbf{K^2}$ be a ribbon 2-knot. The ribbon crossing number, denoted by $r - cr(K^2)$ is a numerical invariant of the ribbon 2-knot $\mathbf{K^2}$. It is known that the degree of the Alexander polynomial of $\mathbf{K^2}$ is less than or equal to $r - cr(K^2)$. In this lecture, we show that $r - cr(K^2)$ is evaluated by coefficients in the Alexander polynomial of $\mathbf{K^2}$. Furthermore, applying this fact, for a classical knot $\mathbf{k^1}$, we also evaluate the crossing number, denoted by $cr(k^1)$.

15:20–16:20 Talk Invited by Topology Section

Takahiro Oba (Kyoto Univ.) Fiber structures and the topology of contact and symplectic manifolds

Summary: Fiber structures such as open books and Lefschetz fibrations have played an important role in the study of the topology of contact and symplectic manifolds. In particular, since combinatorial techniques of mapping class groups of surfaces are well-developed, fiber structures enable us to construct various contact and symplectic manifolds. In contrast, little is known about mapping class groups of higher-dimensional manifolds, and hence this yields a big gap between low and higher dimensions. In the first part of this talk, we survey previous results on the topology of contact and symplectic manifolds from the point of view of fiber structures. In the second part, we discuss how to examine higher dimensions. We especially focus on symplectic manifolds which cannot admit Lefschetz fibrations but admit Lefschetz–Bott fibrations.

Infinite Analysis

March 19th (Tue) Conference Room VI

10:00–11:45

1 Yasuaki Gyoda (Nagoya Univ.) Duality between mutations and rear mutations in cluster algebras · · · · 15
Shogo Fujiwara (Nagoya Univ.)

Summary: The rear mutations are transformations in cluster algebra theory. They are the transformations between rational expressions of cluster variables in terms of the initial cluster under the change of the initial cluster. In this talk, we discuss the duality between the (usual) mutations and the rear mutations through the C-matrices, the G-matrices, and the F-polynomials. In particular, we introduce the F-matrices, which is the maximal degree matrices of the F-polynomials, and show that they have the self-duality which is analogous to the duality between the C- and G-matrices by Nakanishi and Zelevinsky. This is a joint work with Shogo Fujiwara.

2 Yuma Mizuno (Tokyo Tech) Exponents associated with the Y-system of type X_r with level ℓ · · · · · 15

Summary: Let X_r be a finite type Dynkin diagram, and ℓ be a positive integer greater than or equal to two. The Y-system of type X_r with level ℓ is a system of difference equations whose solutions have been proved to have periodicity. For a pair (X_r, ℓ), we define integer sequence called exponents using formulation of the Y-system by cluster algebras. We give a conjecture that express these numbers by the root system of type X_r. We prove the conjecture for (A_1, ℓ) and $(A_r, 2)$ cases.

3 Takao Suzuki (Kindai Univ.) A similarity reduction of q-Drinfeld–Sokolov hierarchy of type $A^{(1)}_{2n+1}$
Naoto Okubo (Aoyama Gakuin Univ.) and q-Garnier system · · · · · 15

Summary: The higher order q-Painlevé system q-$P_{(n+1,n+1)}$ was proposed as a similarity reduction of the q-Drinfeld–Sokolov hierarchy of type $A^{(1)}_{2n+1}$. It is a generalization of Jimbo–Sakai's q-P_{VI} for the basic hypergeometric function, is derived from the compatibility condition of a Lax pair and admits an affine Weyl group symmetry. In this talk, we show that Sakai's q-Garnier system is obtained as a Schlesinger transformation for q-$P_{(n+1,n+1)}$.

4 Naoto Okubo (Aoyama Gakuin Univ.) Generalized q-Painlevé VI systems of type $(A_{2n+1} + A_1 + A_1)^{(1)}$ arising
Takao Suzuki (Kindai Univ.) from cluster algebra · · · · · 15

Summary: In this talk we formulate a group of birational transformations which is isomorphic to an extended affine Weyl group of type $(A_{2n+1} + A_1 + A_1)^{(1)}$ with the aid of mutations and permutations to a mutation-periodic quiver on a torus. This group provides four types of generalizations of Jimbo–Sakai's q-Painlevé VI equation as translations of the affine Weyl group. Then the known three systems are obtained again; the q-Garnier system, a similarity reduction of the lattice q-UC hierarchy and a similarity reduction of the q-Drinfeld–Sokolov hierarchy.

5 Naoto Okubo (Aoyama Gakuin Univ.) Birational realization of Weyl groups and cluster algebras · · · · · 15
Teruhisa Tsuda (Hitotsubashi Univ.)
Tetsu Masuda (Aoyama Gakuin Univ.)

Summary: We propose a systematic way to get birational realization of Weyl groups in terms of cluster algebras.

6 Tomoyuki Takenawa (Tokyo Univ. of Marine Sci. and Tech.) The space of initial conditions for some 4D Painlevé systems ····· 15

Summary: In recent years, research on 4D Painlevé systems have progressed mainly from the viewpoint of isomonodromy deformation of linear equations.In this talk we study the geometric aspects of 4D Painlevé systems by investigating the space of initial conditions in Okamoto–Sakai's sense, which was a powerful tool in the original 2D case. Specifically, starting from known discrete symmetries, we construct the space of initial conditions for some 4D Painlevé systems, and using the Néron–Severi bilattice, clarify the whole group of their discrete symmetries.

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

Hajime Nagoya (Kanazawa Univ.) Conformal field theory and Painlevé equations

Summary: In 2012, Gamayun, Iorgov, and Lisovyy discovered that the tau function of the sixth Painlevé equation is a Fourier expansion of the 4-pt conformal block of the two dimensional conformal field theory with the central charge $c = 1$. I will explain about extensions of their construction to the other Painlevé equations and why conformal blocks appear here.

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

Ryosuke Kodera (Kobe Univ.) Affine Yangians and integrable systems

Summary: We discuss recent developments of representation theory of affine Yangians. The main focus is on the Fock space representation which originates from the study of the spin Calogero–Sutherland model. We also show a relation between Yangians and quantized Coulomb branches associated with quiver representations.

March 20th (Wed) Conference Room VI

10:00–11:45

7 Koichi Hiraide (Ehime Univ.), Chihiro Matsuoka (Osaka City Univ.) Representation with special functions via Borel–Laplace transform to invariant curves of 2D dynamics and chaotic sets I ····· 15

Summary: New analytic functions describing the stable and unstable manifolds at saddle fixed points of Hénon maps are discussed. These functions are obtained by using Borel–Laplace transform, and represented by asymptotic expansions that are convergent in common domains of some half plane and some neighborhood of infinity.

8 Chihiro Matsuoka (Osaka City Univ.), Koichi Hiraide (Ehime Univ.) Representation with special functions via Borel–Laplace transform to invariant curves of 2D dynamics and chaotic sets II ····· 15

Summary: We found a new analytic function to describe the stable and unstable manifolds of nonlinear 2D dynamical systems. An algorithm to construct this function and its concrete form is given by using the Borel–Laplace transform. To obtain the function, the bifurcation structure of a certain Riemann surface is investigated in detail, and it is shown that it is a global solution to the dynamical systems. We prove that the obtained function differs from any existing special functions.

9 Takanori Ayano (Osaka City Univ.), Victor Buchstaber (Steklov Inst. of Math.) Construction of two parametric deformation of KdV-hierarchy and solution by sigma function ····· 15

Summary: Buchstaber and Mikhailov introduced the polynomial Hamiltonian systems in $\mathbb{C}^4$ with two polynomial integrals on the basis of commuting vector fields on the symmetric square of hyperelliptic curves. In this talk, for the case of genus 3, we derive a relationship between these systems and KdV-hierarchy. More precisely, we construct two parametric deformation of the KdV-hierarchy by using the systems. This new system is integrated in the hyperelliptic sigma functions of genus 3.

Summary: In this talk, I introduce a new method to prove fundamental theorems about combinatorics of Young tableaux. The main technique is a realization of jeu de taquin by means of the tropical KP equation.

Summary: The shifted (interpolation) Jack polynomials are a multivariate analogue of the falling factorials. We obtain Pieri type formulas for the shifted Jack polynomials.

Summary: We give explicit formulas for the Kostka polynomials with one column diagrams of type B_n, C_n and D_n.