The 19th "Kagoshima Algebra-Analysis-Geometry Seminar"

February 13th 13:00 - 16th 17:40, 2024
Room 212, Bldg. 2, Faculty of Science, Kagoshima University

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SUPPORTED BY:
Grant-in-Aid for Scientific Research (C) 21K03209 (Minoru Itoh)
Grant-in-Aid for Scientific Research (B) 21H00976 (Shin-ichi Matsumura)
Grant-in-Aid for Scientific Research (C) 23K03117 (Shoji Yokura)
Fostering Joint International Research (A) 19KK0342 (Shin-ichi Matsumura)

PROGRAM

February 13 (Tuesday)

13:00-14:00 : Sho Ejiri (Osaka Metropolitan University)
Decomposition of F-split varieties with semi-ample anti-canonical bundle

14:20-15:20 : Hiroshi Tsukada (Kagoshima University)
Pathwise uniqueness and non-contact property of stochastic differential equations driven by stable processes

15:40-16:40 : Tsukasa Ishibashi (Tohoku University)
Moduli spaces of decorated G-local systems and their stratifications

17:00-18:00 : Yuichiro Hoshi (RIMS)
Mono-anabelian Reconstruction of Solvably Closed Galois Extensions of Number Fields

February 14 (Wednesday)

10:00-11:00 : Young-Jun Choi (Pusan National University)
A Characterization of the Unit ball via Kähler-Einstein potential

11:20-12:20 : Satoshi Naito (Tokyo Institute of Technology)
A presentation of the torus-equivariant quantum K-theory ring of flag manifolds of type A

12:20-14:00 : Lunch break

14:00-15:00 : Takuzo Okada (Kyushu University)
Birationally solid Fano 3-folds

15:20-16:20 : Yuzuru Inahama (Kyushu University)
Large deviations for small noise hypoelliptic diffusion bridges on sub-Riemannian manifolds

16:40-17:40 : Masanobu Kaneko (Kyushu University)
On finite multiple zeta values and related topics

February 15 (Thursday)

10:00-11:00 : Tasuki Kinjo (RIMS)
Mirror symmetry for the moduli space of Higgs bundles and cohomological Donaldson-Thomas theory

11:20-12:20 : Benjamin Collas (RIMS)
Stack Arithmetic and Oda's problem

12:20-14:00 : Lunch break

14:00-15:00 : Hiroyuki Inou (Kyoto University)
Renormalization and combinatorial rigidity for complex dynamics

15:20-16:20 : Tsz On Mario Chan (Pusan National University)
Analytic adjoint ideal sheaves and their application to the injectivity theorem for lc pairs

16:40-17:40 : Takahiro Kitayama (University of Tokyo)
Thurston norm, twisted Euler characteristics and virtual fibering

19:15- Conference Dinner

February 16 (Friday)

10:00-11:00 : Yasuhiko Asao (Fukuoka University)
Magnitude : Study of metric spaces as enriched categories

11:20-12:20 : Toshiyuki Katsura (University of Tokyo)
Kummer surfaces and quadratic line complexes

12:20-14:00 : Lunch break

14:00-17:40 : Free Discussion

ABSTRACTS

Sho Ejiri: Decomposition of F-split varieties with semi-ample anti-canonical bundle

The Beauville–Bogomolov decomposition states that a compact Kähler manifold with numerically trivial canonical bundle admits a finite étale cover that decomposes into a product of three types of manifolds; a torus, simply-connected Calabi–Yau, and symplectic manifolds. Recently, in positive characteristic, Patakfalvi and Zdanowicz established a weak version of Beauville–Bogomolov decomposition, which claims that a smooth projective F-split variety with trivial canonical bundle admits a finite cover that decomposes into a product of two types of varieties; a torus and a projective variety with mild singularities whose augmented irregularity is zero. Here, although the cover is not necessarily étale, it is proved to have a good property in some sense. In this talk, we generalize Patakfalvi and Zdanowicz's theorem to the case when the anti-canonical bundle is numerically equivalent to a semi-ample line bundle. Its characteristic-zero counterpart has been shown by using Ambro's theorem and the abundance theorem for numerically trivial canonical bundles.

Hiroshi Tsukada: Pathwise uniqueness and non-contact property of stochastic differential equations driven by stable processes

We consider one-dimensional stochastic differential equations (SDEs) driven by strictly stable processes. This driving process is a Lévy process with the scaling property. It is well-known that the pathwise uniqueness of solutions to the SDE with Lipshitz continuous coefficients holds. In this talk, we give some non-Lipschitz conditions on diffusion and drift coefficients under which the pathwise uniqueness of solutions to the SDE holds. In addition, we give some sufficient conditions for the non-contact property of solutions to the SDEs with different initial values.

Tsukasa Ishibashi: Moduli spaces of decorated G-local systems and their stratifications

The moduli spaces of decorated G-local systems on a marked surface are introduced as an "algebro-geometric avatar" of the higher Teichmuller theory, which have been also studied intensively as important examples of cluster varieties. When the marked surface is a small one, the moduli space contains various algebraic varieties that have been studied in the context of representation theory. In this talk, I will explain the relations between the moduli space and various algebraic varieties, and also talk on "stratifications" of the

moduli space introduced by myself with collaborators, and its applications. This talk is based on a joint work with Hironori Oya and Linhui Shen.

Yuichiro Hoshi: Mono-anabelian Reconstruction of Solvably Closed Galois Extensions of Number Fields

A theorem of Uchida asserts that every continuous isomorphism between the Galois groups of solvably closed Galois field extensions of number fields arises from a unique isomorphism between the solvably closed Galois field extensions. In particular, the isomorphism class of a solvably closed Galois field extension of a number field is completely determined by the isomorphism class of the associated Galois group. On the other hand, neither the statement of this theorem nor the proof of this theorem yields an "explicit reconstruction" of the given solvably closed Galois field extension. Moreover, such an "explicit reconstruction" is often studied and applied in the recent research of anabelian geometry and in inter-universal Teichmuller theory. In this talk, we discuss a functorial group-theoretic algorithm for reconstructing, from the Galois group of a solvably closed Galois field extension of a number field, the given solvably closed Galois extension field equipped with the natural Galois action.

Young-Jun Choi: A Characterization of the Unit ball via Kähler-Einstein potential

The uniformization theorem for Riemann surfaces says that any universal covering of Riemann surfaces is one of the three possibilities: the Riemann sphere, the complex plane, or the unit disc. However, extending this theorem to higher dimensions is not feasible due to the lack of the Riemann mapping theorem in higher dimensions. Consequently, the classification of universal coverings of compact Kähler manifolds becomes an important problem in this context. In case of negatively curved case, it is well-known that every bounded symmetric domain admits a compact quotient.

In this talk, we will discuss a characterization of the unit ball in view of this context. This is a joint work with Kang-Hyurk Lee and Aeryeong Seo.

Satoshi Naito: A presentation of the torus-equivariant quantum K-theory ring of flag manifolds of type A

The study of level-zero Demazure submodules (of extremal weight modules) over a quantum affine algebra has many applications to quantum Schubert calculus. As one good example, we give a Borel-type presentation of the torus-equivariant quantum K-theory ring of flag manifolds of type A, by making use of the inverse Chevalley formula for the equivariant K-group of

semi-infinite flag manifolds. This talk is based on joint work with D. Sagaki and T. Maeno.

Takuzo Okada: Birationally solid Fano 3-folds

Luroth theorem can be translated to an algebro-geometric statement: a unirational curve is rational. Its higher dimensional generalization is called Luroth problem and it asks whether a unirational variety is rational. Fano varieties are thought of as primal objects to consider for providing counterexamples. In the early 1970s, Iskovskikh and Manin showed that any smooth quartic 3-fold, which is a Fano 3-fold, is irrational by introducing the notion of birational rigidity. In this talk I will explain the notion of birational rigidity of Fano varieties, and then explain its generalized notion of birational solidity which implies irrationality. Then I will also explain a recent result on the classification of birationally solid Fano 3-fold weighted hypersurfaces.

Yuzuru Inahama: Large deviations for small noise hypoelliptic diffusion bridges on sub-Riemannian manifolds

In this talk we discuss a large deviation principle of Freidlin-Wentzell type for pinned hypoelliptic diffusion measures associated with a natural sub-Laplacian on a compact sub-Riemannian manifold. To prove this large deviation principle, we use rough path theory and manifold-valued Malliavin calculus. At the beginning of the talk, we give a very simple introduction of large deviation principles, which is one of the three biggest limit theorems in modern probability theory.

Masanobu Kaneko: On finite multiple zeta values and related topics

We first give an introductory survey on finite multiple zeta values. There are two completely different finite analogues of the classical, real multiple zeta value, which has been intensively studied in recent decades from various viewpoints. We mainly discuss an amazing conjecture relating these two analogues in a concrete manner. We also discuss our recent discovery on some finite analogues of Euler's constant.

Tasuki Kinjo: Mirror symmetry for the moduli space of Higgs bundles and cohomological Donaldson-Thomas theory

The mirror symmetry for the moduli spaces of G-Higgs bundles on Riemann surfaces has close connection with the geometric Langlands conjecture. More precisely, the moduli space of G-Higgs bundles is expected to be the mirror dual of the moduli space for the Langlands dual of G, and the homological mirrorsymmetry for them can be thought of as the Dolbeault version of the geometric Langlands conjecture.

In this talk, we focus on the topological mirror symmetry (i.e., the symmetry of the Hodge number) for the moduli space of G-Higgs bundles. Since these moduli spaces are singular, the ordinary Hodge number does not satisfy the expected symmetry in general. We will propose a definition of the "correct'' Hodge number for these moduli spaces using an idea from cohomological Donaldson-Thomas theory and explain some speculations and known results for it. In particular, we will see that the modified Hodge number has the symmetry expected from the mirror conjecture in the case of $G = \mathrm{GL}_n$. This talk is partly based on joint work with Naoki Koseki.

Benjamin Collas: Stack Arithmetic and Oda's problem

At MPI Bonn 1993, Oda's presented a conjecture regarding the fixed field of the universal l-monodromy representation of moduli space of curves that is expected to be independent of the topological data of the curves. Oda's conjecture since acted as a stimulating problem of arithmetic geometry with multiple approaches – group/Lie theoretic (Matsumoto 96), Galois arithmetic (Ihara-Nakamura 97), and combinatorial anabelian geometric (Hoshi-Mochizuki 11) – to be settled with joint efforts of Nakamura-Tako-Ueno et al.

This talk will introduce a stack version of Oda's conjecture (and its proof), which is closer in its spirit to Oda's original prediction, and which we show, provides another proof of its original schematic version (jt w/ Philip JSPS).

Hiroyuki Inou: Renormalization and combinatorial rigidity for complex dynamics

In the study of complex dynamics, the phase space is divided into the stable part (Fatou set) and the chaotic part (Julia set). The Mandelbrot set, one of the most well-known fractal sets, is defined by the set of parameters of quadratic polynomials for which the Julia sets are connected. It is known that the Mandelbrot set is connected, and conjectured that it is locally connected (known as the MLC conjecture). The local connectivity is related to density of hyperbolicity and non-existence of invariant line fields, so it is important in understanding dynamics. MLC is equivalent to the combinatorial rigidity conjecture for quadratic polynomials, which remains open only for some infinitely renormalizable polynomials. In this talk, we give a brief overview of local connectivity of the Mandelbrot set and Julia sets, and explain counterexamples for the combinatorial rigidity conjecture in the cubic family.

Tsz On Mario Chan: Analytic adjoint ideal sheaves and their application to the injectivity theorem for lc pairs

Given a complex manifold X and a reduced snc divisor D on it, an analytic adjoint ideal sheaf of index σ consists of all the germs of holomorphic functions locally L^2 with respect to a given weight which remains to be locally L^2 with respect to the weight after being restricted to each of the σ-lc centres of (X, D) (i.e. σ-codimensional components of any intersections of irreducible components of D). The analytic adjoint ideal sheaves of various indices, together with the associated residue maps, provide a convenient way to do induction on the codimension of the lc centres when handling questions on the cohomology of the lc pair (X, D). The associated residue computation also provides equalities between the sum of inner products between certain harmonic forms on the σ-lc centres to the sum of those on the $(\sigma + 1)$-lc centres. This turns out to be useful for the analysis while considering the reduction on dimension. In this talk, the analytic adjoint ideal sheaves are introduced. Their use, as well as the associated residue computation, is then illustrated via a proof of the injectivity theorem for lc pairs (X, D) with X being compact Khler. The content of this talk is based on the joint work with Young-Jun Choi and Shin-ichi Matsumura.

Takahiro Kitayama: Thurston norm, twisted Euler characteristics and virtual fibering

In 3-dimensional topology it is a fundamental and difficult problem in general to understand what kinds of subsurfaces a given manifold contains. The Thurston norm on the first cohomology group measures the topological complexity of subsurfaces, and is known to be detected by Alexander invariants of the fundamental group associated with linear representations. From the viewpoint of the celebrated virtual fibering theorem of Agol and its generalization by Kielak, I will explain how this framework extends not only for 3-dimensional manifolds and their fundamental groups but also for a more general class of residually finite groups.

Yasuhiko Asao: Magnitude : Study of metric spaces as enriched categories

As Lawvere pointed out, metric spaces can be considered as categories enriched over the monoidal category of positive reals: $[0, \infty)$. From this viewpoint, Leinster defined the Euler characteristic of metric spaces as an enriched version of that of small categories, which is called magnitude. The development of the magnitude theory has several aspects : as graph theory, convex geometry, and enriched category theory. In this talk, I will explain

fundamental concepts, connection to other geometric/topological quantities, and recent development of magnitude, mainly from an algebraic aspect.

Toshiyuki Katsura: Kummer surfaces and quadratic line complexes

The lines in the 3-dimensional projective space $\mathbf{P}^3$ are parametrized by a nonsingular quadric surface G (a Grassmann manifold) in $\mathbf{P}^5$. In the late 19th century, Klein took one more quadric Q in $\mathbf{P}^5$ and considered the pencil made by G and Q over the field of complex numbers . By using the pencil, he found a beautiful geometry which include the lines in $\mathbf{P}^3$, curves C of genus 2, their Jacobian varieties $J(C)$ and Kummer surfaces $\mathrm{Km}(J(C))$. His theory holds also over the field of positive characteristic $p \neq 2$. However, if $p = 2$, the situation is very different and special phenomena appear. In this talk, I will first give a survey of the classical theory by Klein and then explain the theory which we established in the case of characteristic 2. This is a joint work with S. Kondo.