Monday, 19 January

R101, 13:30-14:00

Tomomi Ozawa (Tohoku University)

Constant terms of Eisenstein series over a totally real field

A modular form is a holomorphic function defined on the upper half plane $\mathfrak{H} = \{z \in \mathbb{C} \mid \mathrm{Im}(z) > 0\}$ which satisfies certain relations called "modularity property". The theory of modular forms has been actively studied and played a key role in number theory since it was found in the theory of elliptic functions and quadratic forms in the early 19th century. Eisenstein series is one of the first examples of modular forms. The simplest possible Eisenstein series is a holomorphic function $E_k(z)$ defined on $\mathfrak{H}$ given by

$$E_k(z) = \frac{(k-1)!}{2(2\pi i)^k} \sum_{\substack{(a,b)\in\mathbb{Z}^2,\\ (a,b)\neq(0,0)}} \frac{1}{(az+b)^k} \quad (z \in \mathfrak{H})$$

for each even integer $k \geq 4$. It is verified that $E_k(z+1) = E_k(z)$ and hence it is expanded as

$$E_k(z) = 2^{-1}\zeta(1-k) + \sum_{n=1}^{\infty} \left(\sum_{0<t|n} t^{k-1} \right) q^n \quad (q = \exp(2\pi i z)).$$

Here $\zeta(s)$ is the Riemann-zeta function and t runs over the set of positive divisors of n. Eisenstein series is a modular form closely related to another important object in number theory, namely L-functions (L-function is a generalization of the Riemann-zeta function).

In this talk, we compute constant terms of Eisenstein series defined over a totally real field at all cusps. The following study by M. Ohta motivated me to compute the constant terms of Eisenstein series: in 2003 Ohta defined and computed congruence modules related to Eisenstein series defined over the field $\mathbb{Q}$ of rational numbers. His theory of congruence modules has been applied to several important problems concerning special values of (Dirichlet) L-functions. In his computation, the constant terms of Eisenstein series over $\mathbb{Q}$ at all the equivalence classes of cusps are necessary. We explicitly describe the constant terms of Eisenstein series defined over a general totally real field at each equivalence class of cusps, in terms of special values of Hecke L-functions.

Keyword: modular forms, Eisenstein series, special values of L-functions.

R101, 14:10-14:40

Tse-Chung Yang (Academia Sinica)

Supersingular abelian surfaces and Eichler class number formula

Let F be a totally real field with ring of integers $\mathscr{O}_F$, and D be a totally definite quaternion algebra over F. A well-known formula established by Eichler and then extended by Körner computes the class number of any $\mathscr{O}_F$-order in D. In this talk, we generalize the Eichler class number formula so that it works for arbitrary $\mathbb{Z}$-orders in D. The motivation is to count the isomorphism classes of supersingular abelian surfaces in a simple isogeny class over a prime finite field $\mathbb{F}_p$. We will give an explicit formula for the number of these

isomorphism classes for all primes p. Our tools are the Honda-Tate theory and extended methods in Eichler's class number formula.

Keywords: supersingular abelian variety, totally definite quaternion algebra, Eichler class number formula.

R101, 14:50-15:20

Fuetaro Yobuko (Tohoku University)

Mass Formula for Supersingular Abelian Varieties

The Eichler-Duering mass formula says that the weighted number of isomorphism classes of supersingular elliptic curves over an algebraically closed field of characteristic p is expressed as a simple polynomial in p. In 2009 C.-F. Yu and J.-D. Yu generalized this formula for supersingular abelian surfaces. In this talk, we show mass formula for supersingular abelian three-folds.

Keyword: Abelian varieties, Supersingular, Mass formula.

R101, 15:40-16:10

Yibin Ren (Fudan University)

Rigidity Theorems for Complete Sasakian Manifolds with Constant Pseudo-Hermitian Scalar Curvature

The orthogonal decomposition of the Webster curvature provides us a way to characterize some canonical metrics on a pseudo-Hermitian manifold. We derive some subelliptic differential inequalities from the Weitzenb?ck formulas for the traceless pseudo-Hermitian Ricci tensor of Sasakian manifolds with constant pseudo-Hermitian scalar curvature and the Chern-Moser tensor of the Sasakian pseudo-Einstein manifolds respectively. By means of either subelliptic estimates or maximum principle, some rigidity theorems are established to characterize Sasakian pseudo-Einstein manifolds among Sasakian manifolds with constant pseudo-Hermitian scalar curvature and Sasakian space forms among Sasakian pseudo-Einstein manifolds respectively.

Keyword: Rigidity theorem, Chern-Moser tensor, CR Yamabe invariant, Sasakian manifold, pseudo-Einstein manifold, pseudo-Hermitian space form.

R101, 16:20-16:50

Jifu Xiao (Kyoto University)

Toric degeneration, Conifold Transition, and Quantum Cohomology

In this talk,we will give a report of the joint work with Iritani Hiroshi. Mirror symmetry was first discovered for the Calabi-Yau Manifolds. That is for a pair of Calabi-Yau 3-folds (M,W), the A-model of M and B-model of W are equivalent. Lately, this mirror symmetry phenomena was generalized to Fano varieties.

Fano varieties can degenerate to singular toric varieties. We study the relationship between the small quantum cohomology of flag varieties and that of the resolution of their singular toric degenerations.

R101, 17:00-17:30

Toshihisa Kubo (University of Tokyo)

Covariant differential operators and the Rankin–Cohen bracket

The goal of this talk is to find explicit formulas for certain $SL(2,\mathbb{R})$-intertwining differential operators from $C^\infty(\mathbb{R}^2)\oplus C^\infty(\mathbb{R}^2)$ to $C^\infty(\mathbb{R})$. The Rankin–Cohen bracket, Jacobi polynomials, and Gegenbauer polynomials play a key role.

Keyword: reductive Lie groups, conformal geometry, Jacobi polynomials, Gegenbauer polynomials, branching law, Verma modules.

Tuesday, 20 January

R101, 13:00-13:30

Keita Kunikawa (Tohoku University)

A Bernstein type theorem for ancient solutions to the mean curvature flow

In this talk, we consider ancient solutions to the mean curvature flow. Ancient solutions are special solutions which are defined for all negative time $(-\infty, 0]$. They arise as tangent flows near singularities, and they are good asymptotic models of singularities. Therefore, in order to investigate singularities, it is effective to study ancient solutions. The class of ancient solutions includes all self-shrinkers and translating solitons which are submanifolds having an interesting property, namely, the self-similarity under the flow.

Since the late 1980's many mathematicians have studied the geometry of self-shrinkers and translating solitons. However, the geometry of generic ancient solutions is less-known so far. Therefore we want to deal with this problem, especially in the entire graphic cases. Under certain curvature and slope conditions, we obtain a Bernstein type theorem of ancient solutions. Roughly speaking, the main result says that there are no non-trivial ancient solutions with bounded slope.

Keywords: Mean curvature flow, ancient solution, Bernstein type theorem.

R101, 13:40-14:10

Yosuke Morita (University of Tokyo)

A necessary condition for the existence of compact manifolds locally modelled on homogeneous spaces

A manifold is called locally modelled on G/H if it is covered by open sets that are diffeomorphic to open sets of G/H and the transition functions are locally given by translation by elements of G. In this talk, we provide an obstruction for that a given homogeneous space G/H admits a compact manifold locally modelled

thereon. For instance, there does not exists a compact manifold locally modelled on $SL(p+q,\mathbb{R})/SO(p,q)$ if p, q are odd. The key tool of the proof is the homomorphism constructed by Kobayashi–Ono that gives a "uniform lower bound" of cohomology of the compact manifolds locally modelled on G/H.

R101, 14:20-14:50

Woocheol Choi (Seoul National University)

Qualitative properties of multi-bubble solutions for nonlinear elliptic equations involving critical exponents

The objective of this paper is to obtain qualitative characteristics of multi-bubble solutions to the Lane-Emden-Fowler equations with slightly subcritical exponents given any dimension $n \geq 3$. By examining the linearized problem at each m-bubble solution, we provide a number of estimates on the first $(n+2)m$-eigenvalues and their corresponding eigenfunctions. Specifically, we present a new proof of the classical theorem due to Bahri-Li-Rey (1995) [**?**] which states that if $n \geq 4$, then the Morse index of a multi-bubble solution is governed by a certain symmetric matrix whose component consists of a combination of Green's function, the Robin function, and their first and second derivatives. Our proof also allows us to handle the intricate case $n = 3$.

Keyword: Asymptotic behavior of solutions, critical exponents, linearized problem, multi-bubble solutions.

R101, 15:10-15:40

Taekyung Kim (Seoul National University)

A conjecture of Gross and Zagier for elliptic curves having rational 2-torsion points

One of the major theme in the arithmetic of elliptic curves is to determine ranks of the Mordell–Weil groups of elliptic curves. Theoretically, it is completely done provided well-known Birch and Swinnerton-Dyer conjecture (BSD for short). One of the biggest breakthrough toward the BSD conjecture was given by Gross and Zagier in 1980s. Among other things, assuming the elliptic curve E has the Mordell–Weil group $E(\mathbf{Q})$ of rank 1, they proved the BSD conjectural formula for the value at $s = 1$ of the first derivative of the Hasse–Weil L-function $L(E, s)$ is true up to a non-zero rational number. By mixing this result with the original BSD formula, we get another conjecture claiming that the order of the torsion subgroup of $E(\mathbf{Q})$ divides certain arithmetic invariants of the curve.

In this talk, I introduce and discuss about this conjecture. I will also convey some ideas and tools used to prove the conjecture when the elliptic curve has a rational 2-torsion point.

This is a joint work with Prof D. Byeon in Seoul National University.

R101, 15:50-16:20

Wataru Kai (University of Tokyo)

On the Albanese cokernel of varieties over p-adic fields

Let X be a smooth projective variety over a field K. We are interested in the cokernel of the Albanese map of zero-cycles

$$\operatorname{cok}\left(\mathrm{CH}_0(X)^{\deg=0} \to \mathrm{Alb}_X(K)\right).$$

It is always a torsion abelian group and is trivial over algebraically closed fields and finite fields as well as for abelian varieties. It is finite over number fields and p-adic fields.

In this talk we discuss the case when K is a p-adic field. We present a conjectural formula describing the Albanese cokernel in terms of the Néron-Severi group and provide a proof under additional assumptions on an integral model of X.

We will also briefly mention the local-global problem for the Albanese-cokernel; the abelian group on the "local side" turns out to be a finite group by our main theorem.

R101, 16:30-17:00

Hung-Hsun Chen (National Chiao Tung University)

Nonemptiness Problems of wang tiles with three colors

This investigation studies nonemptiness problems of plane edge coloring with three colors. In the edge coloring (or Wang tiles) of a plane, unit squares with colored edges that have one of p colors are arranged side by side such that the touching edges of the adjacent tiles have the same colors. Given a basic set B of Wang tiles, the nonemptiness problem is to determine whether or not $\Sigma(B) \neq \emptyset$, where $\Sigma(B)$ is the set of all global patterns on $\mathbb{Z}^2$ that can be constructed from the Wang tiles in B. Wang's conjecture is that for any B of Wang tiles, $\Sigma(B) \neq \emptyset$ if and only if $P(B) \neq \emptyset$, where $P(B)$ is the set of all periodic patterns on $\mathbb{Z}^2$ that can be generated by the tiles in B. When $p \geq 5$, Wang's conjecture is known to be wrong. When $p = 2$, the conjecture is true. This study proves that when $p = 3$, the conjecture is also true. If $P(B) \neq \emptyset$, then B has a subset B' of minimal cycle generators such that $P(B') \neq \emptyset$ and $P(B'') = \emptyset$ for $B'' \subsetneq B'$. This study demonstrates that the set $C(3)$ of all minimal cycle generators contains 787, 605 members that can be classified into 2, 906 equivalence classes. $N(3)$ is the set of all maximal non-cycle generators: if $B \in N(3)$, then $P(B) = \emptyset$ and $P(\bar{B}) \neq \emptyset$ for $\bar{B} \supsetneq B$. Wang's conjecture is shown to be true by proving that $B \in N(3)$ implies $\Sigma(B) = \emptyset$.

Keyword: nonemptiness, Wang tiles, decidability, edge coloring, periodic patterns, transition matrix.

R101, 17:10-17:40

Mojallal Seyed Ahmad (Sungkyunkwan University)

On the Laplacian energy of graphs

Let G be a simple graph with n vertices and m edges with Δ and δ as maximum and minimum degrees of G. Also let $\mu_1, \mu_2, \ldots, \mu_n = 0$ be the eigenvalues of the Laplacian matrix of graph G. The Laplacian energy of the graph G is defined as

$$LE = LE(G) = \sum_{i=1}^{n} |\mu_i - \frac{2m}{n}|.$$

In this talk, we present some lower and upper bounds for LE of graph G in terms of n, the number of edges m and the maximum degree Δ. Also we give a Nordhaus-Gaddum-type result for Laplacian energy of graphs. Moreover, we obtain a relation between Laplacian energy and Laplacian–energy–like invariant of graphs.

Keyword: Graph, Laplacian Matrix, Laplacian Eigenvalues, Laplacian Energy.

Wednesday, 21 January

R101, 9:00-9:30

Min-Ho Song (Sungkyunkwan University)

Lie theory in the Riordan group

A Riordan matrix M denoted $(g(z), f(z))$ or (g, f) is an infinite lower triangular array determined by a pair of formal power series $g, f \in \mathbb{R}[[z]]$ in which its kth column has the generating function $g(z)f(z)^k$ where $k \in \mathbb{N}_0$, $g(0) \neq 0$, $f(0) = 0$ and $f'(0) \neq 0$. The set of all Riordan matrices forms a group called the Riordan group. In this talk, we are interested in the $n \times n$ Riordan submatrix that lies in the rows and columns of M indexed by $\{0, 1, \ldots, n-1\}$. The set of all $n \times n$ Riordan submatrices is denoted as $\mathscr{R}_n$. The purpose of this talk is to find the structures of the Lie algebra and sub Lie algebras corresponding to the finite Riordan group and several well-known Riordan subgroups, respectively. Specifically, we first prove that $\mathscr{R}_n$ is a matrix Lie group. Next, we find the structure of the Lie algebra $\mathscr{L}(\mathscr{R}_n)$ of $\mathscr{R}_n$ as the tangent space of $\mathscr{R}_n$ at the unit element, $\exp(0A) = I$:

$$\mathscr{L}(\mathscr{R}_n) := \{A \in M_n(\mathbb{R}) \mid \exp(tA) \in \mathscr{R}_n \text{ for all } t \in \mathbb{R}\}.$$

We then find the Lie subalgebras of $\mathscr{L}(\mathscr{R}_n)$ corresponding to the well-known Riordan subgroups: Appell, Lagrange, Bell, checkerboard, derivative, stochastic subgroups, etc. New subgroups of $\mathscr{R}_n$ are also derived from certain Lie subalgebras of $\mathscr{L}(\mathscr{R}_n)$. Finally, we give a way to apply Lie theory to a generalized Riordan group.

Keyword: Riordan matrix, Riordan group, matrix Lie group, Riordan Lie algebra.

R101, 9:40-10:10

Maho Yokota (Kyoto University)

Noether probrem for some group

Let K be a field and G be a finite group acting on a rational function field $K(x_g : g \in G)$ by $x_g \cdot h = x_{gh}$ for any $g, h \in G$. Noether problem asks whether the invariant field $K(G) := K(x_g : g \in G)^G$ is rational over K or not. This problem is simple, however the answer depends greatly on the property of G and K, and known results are far from general answer. About this problem, it is known that $K(G)$ is rational over K if K is algebric closed and G has a faithful representation of at most degree three.

I found if order of G is odd, the assumption about faithful representation can be weakened. Namely, we only need the following assumptions; K is algebraic closed and G has a faithful representation which is the direct sum of representations of at most degree three (one or three). In this talk, I talk about introduction

to Noether problem at first, about outline of the proof of my theorem.

R101, 10:20-10:50

Arata Minamide (Kyoto University)

Indecomposability of Anabelian Profinite Groups

Classically, it is well-known that various **a**nabelian profinite groups, i.e., profinite groups which appear in *anabelian geometry*, are **c**enter-free. In this talk, I will introduce the **i**ndecomposability, which is also a *g*roup-theoretic property of profinite group, and explain that various **a**nabelian profinite groups satisfy the **i**ndecomposability. Finally, I will discuss the topic of indecomposability in the context of the theory of *c*ombinatorial anabelian geometry and pose the question: Is the **G**rothendieck-Teichmüller group GT indecomposable? I will give an *affirmative answer* to a *p*ro-*l* version of this question.

R101, 11:00-11:30

Yu Yang (Kyoto University)

Fundamental Groups and Geometry of Coverings of Curves

In this talk, we will discuss geometry of coverings of curves from the point of view of fundamental groups. After recalling some basic facts concerning the fundamental groups and curves over a complete discrete valuation ring, we want to explain some results of geometry of coverings called resolution nonsingularities.

Keyword: (log) stable curve, (log) etale covering, (log) etale fundamental groups.

R101, 11:40-12:10

Takashi Komatsu (Tohoku University)

Asymptotic Analysis of Steric Poisson-Nernst-Planck Model for Multi-species Ions

We investigate discrete-time quantum walks on graphs. The notion of discrete-time quantum walks was introduced as a quantum version of random walks. Recently, quantum walks have been intensively studied in connection with quantum computing and quantum physics. It is interesting to see that the asymptotic behavior of quantum walk on the one-dimensional line (the Konno function) is different from that of the classical random walk (Gaussian). We are interested in higher dimensional extension.

In this talk, we consider fundamental properties of quantum walks on graphs. For example, there are the limit distribution and localization. We will discuss their properties of quantum walks on the two-dimensional lattice and triangular lattice. Firstly, we will explain their properties through quantum walks on the one-dimensional line. Secondly, we will propose a model of discrete-time quantum walks on the square lattice without localization and give the limiting distribution of our quantum walk. Next, We see that the Konno function appears as the density function with respect to radial direction in our quantum walk. Finally, we will discuss discrete-time quantum walks with localization on the triangular lattice.

Keyword: Discrete-time quantum walk, limit distribution, localization, square lattice, triangular lattice.

Thursday, 22 January

R101, 13:00-13:30

Sho Hasui (Kyoto University)

On the classification of bundle-type quasitoric manifolds over a cube

Toric topologists have discussed several types of cohomological rigidity problems. For example, the cohomological rigidity problem for quasitoric manifolds asks whether quasitoric manifolds are classified only by their cohomology rings or not. Many of these problems are far from being solved, and so is the example.

Some toric topologists restrict themselves to the case of Bott manifolds, namely, iterated $\mathbf{C}P^1$-bundles over $\mathbf{C}P^1$ with some good properties. However, as well as many of other cohomological rigidity problems, the cohomological rigidity problem for Bott manifolds has not been solved yet. In this talk, we consider the $\mathbf{C}P^2\#\mathbf{C}P^2$-bundle version of this problem, and show that the cohomological rigidity problem is affirmative for the class of such manifolds.

R101, 13:40-14:10

Kim, Hyun Jin (Ewha Womans University)

p-ary complementary information set codes

We classify complementary information set codes (for short, CIS codes) over a finite field $GF(p)$, where p is an odd prime. We find a method for constructing CIS codes over $GF(p)$. We also find a criterion for checking equivalence of CIS codes over $GF(p)$. We complete the classification of all inequivalent CIS codes over $GF(p)$ of lengths up to 8 for $p = 3, 5, 7$ using this construction and criterion. The class of CIS codes over $GF(p)$ includes self-dual codes over $GF(p)$, and some CIS codes are formally self-dual codes as well. Furthermore, we prove that long CIS codes over $GF(p)$ meet the Gilbert-Vashamov bound.
This is a joint work with Yoonjin Lee.

Keywords: code, self-dual code, complementary information set code, equivalence, Gilbert-Vashamov bound

R101, 14:20-14:50

Yuki Arano (University of Tokyo)

Unitary spherical representations of Drinfeld doubles

It is known that the Drinfeld double of a q-deformation of a compact Lie group can be seen as a quantization of the complexification of the original compact Lie group. In this talk, we investigate the unitary representation theory of such Drinfeld double via its analogy to that of the complex Lie group. As an application, we show central property (T) for $SUq(2n + 1)$.

Keyword: Quantum groups, Drinfeld double, unitary representations, property (T).

R101, 15:10-15:40

Se-Jin Oh (Seoul National University)

Monoidal categorification of Cluster algebras

In this talk, I will first introduce the notion of the monoidal categorifications of Cluster algebras. Then I will give a criterion of monoidal categorifications of Cluster algebras via categories over KLR-algebras. This is a joint work with Kang, Kashiwara and Kim.

R101, 15:50-16:20

Yoshiyasu Fukumoto (Kyoto University)

Maps preserving the K-area

K-area is an invariant for Riemannian manifolds. Roughly speaking, it measures how small C^0 curvature norms can be achieved for "non-trivial" vector bundles over a Riemannian manifold. Originally K-area is introduced by Gromov as an obstruction to the existence of positive scalar curvature. [**?**]

K-area is studied mainly from the topological or index theoritical point of view like [**?**] and [**?**], but today we will observe the local aspect of K-area. The local behavior of K-area can be considered similar to that of Symplectic capacity. In this talk, we will consider what kind of maps preserve the K-area and show that such maps are restricted to isometry. This can be regarded as an analogy of the fact that maps preserving symplectic capacity are always symplectic or anti-symplectic.

R101, 16:30-17:00

Changwei Xiong (Tsinghua University)

Stability of capillary hypersurfaces in a Euclidean ball

The capillary hypersurface in a Euclidean ball is the one having constant mean curvature and constant contact angle with the boundary of the ball. In this talk I will discuss the stability of this geometric object and prove that capillary hypersurfaces with some symmetry in a Euclidean ball are unstable. This is joint work with Prof. Haizhong Li.