Low dimensional topology and number theory IX

March 15 - 18, 2017
AiRIMaQ Seminar Room, Innovation Plaza, Momochihama, Fukuoka, JAPAN

Program

March 15 (Wednesday)
9:30 ∼ 10:30
Toshie Takata (Kyushu University)
The slope conjecture and periodic construction

10:50 ∼ 11:50
Shunsuke Tsuji (The University of Tokyo)
Construction of an invariant for integral homology spheres

14:00∼ 15:00
Shinya Harada (The University of Tokyo)
Deformation varieties of hyperbolic two-bridge link complements and their zeta functions

15:20 ∼ 16:20
Megumi Takata (Kyushu University)
The infinite base change lifting associated to an APF extension of a mixed characteristic local field

March 16 (Thursday)
9:30 ∼ 10:30
Sakie Suzuki (Kyoto University, RIMS)
The universal quantum invariant and colored ideal triangulation

10:50 ∼ 11:50
Seidai Yasuda (Osaka University)
Ihara bracket for group schemes

14:00 ∼ 15:00
Nariya Kawazumi (The University of Tokyo)
The Kashiwara-Vergne problem and the Goldman-Turaev Lie bialgebra in genus zero

15:20 ∼ 16:20
Jinsung Park (Korea Institute for Advanced Study)
Reidemeister torsion, complex volume, and Zograf infinite product

March 17 (Friday)
9:30 ∼ 10:30
Yasushi Mizusawa (Nagoya Institute of Technology)
On pro-p link groups of number fields

10:50 ∼ 11:50
Jun Ueki (The University of Tokyo)
p-adic Mahler measure, entropy, and $\widehat{\mathbb{Z}}$-covers

14:00 ∼15:00
Eiko Kin (Osaka University)
Small asymptotic translation lengths of pseudo-Anosov maps on the curve complex

15:20 ∼ 15:40
Junhyeung Kim (Kyushu University)
On the foliation cohomology groups and dynamical zeta functions for surface bundles over S^1

15:50 ∼ 16:40
Masanori Morishita (Kyushu University)
Local symbols and the reciprocity law on foliated 3-manifolds

March 18 (Saturday)
9:30 ∼ 10:30
Takefumi Nosaka (Kyushu University)
Massey products of free groups and Milnor-Orr link invariants.

10:50 ∼ 11:50
Kazuo Habiro (Kyoto University, RIMS)
The Kontsevich integral for bottom tangles in handlebodies

14:00 ∼ 15:00
Tetsuya Ito (Osaka University)
On a structure of Dehn surgery along knots and LMO invariant

Abstract

Kazuo Habiro (Kyoto University, RIMS)
The Kontsevich integral for bottom tangles in handlebodies
Using the Kontsevich integral, we define a functor from the category $\mathcal{B}$ of bottom tangles in handlebodies to a category $\mathbf{A}$ of chord diagrams. This functor can be thought of as a (partial) refinement of the LMO functor on Lagrangian cobordisms. I also plan to explain the algebraic structure of the category $\mathbf{A}$. This is joint work with Gwenael Massuyeau.

Shinya Harada (The University of Tokyo)
Deformation varieties of hyperbolic two-bridge link complements and their zeta functions
After a brief survey on SL_2-character varieties and their zeta functions of hyperbolic 3-manifolds, I will talk on a work in progress about the deformation varieties attached to the canonical decompositions of certain hyperbolic two-bridge link complements and their zeta functions.

Tetsuya Ito (Osaka University)
On a structure of Dehn surgery along knots and LMO invariant
In this talk we use the LMO invariant to study a structure of Dehn surgery along a knot in S^3. Through a computation of the LMO invariant, we give various constraints for a knot to admit cosmetic surgery (Dehn surgery along the same knot with different slopes, yielding the same 3-manifold), or the Lens space surgeries.

Nariya Kawazumi (The University of Tokyo)
The Kashiwara-Vergne problem and the Goldman-Turaev Lie bialgebra in genus zero
In view of results of Goldman and Turaev, the free vector space over the free loops on an (connected) oriented surface has a natural Lie bialgebra structure. The Goldman bracket has a formal description by using a special (or symplectic) expansion of the fundamental group of the surface. It is natural to ask for a formal description of the Turaev cobracket. This Lie bialgebra is closely related to the mapping class group of the surface. In this talk we will show how to obtain a formal description of the Goldman-Turaev Lie bialgebra for genus 0 using a solution of the Kashiwara-Vergne problem. A similar result was recently obtained by Massuyeau using the Kontsevich integral. If time permits, I would like to discuss positive genus analogues of the result. This talk is based on

a joint work by A. Alekseev, N. Kawazumi, Y. Kuno and F. Naef.

Junhyeung Kim (Kyushu University)
On the foliation cohomology groups and dynamical zeta functions for surface bundles over S^1
C. Deninger initiated the cohomological study of the dynamical zeta function for a manifold which is equipped with a 1-codimensional foliation and the transversal flow. In this talk, we give concrete descriptions of the foliation cohomology and the dynamical zeta function for the simplest example, namely, a surface bundle over S^1. We also discuss some future problems.

Eiko Kin (Osaka University)
Small asymptotic translation lengths of pseudo-Anosov maps on the curve complex
We consider the mapping class groups on the closed surface S_g of genus g. We are interested in two invariants of pseudo-Anosov mapping classes. The one is the entropy (the logarithm of the stretch factor of the pseudo-Anosov map). The other is the asymptotic translation distance on the complex of curves. It is known that fixing the genus g, both invariants have minima. Furthermore the minimal entropies for S_g behaves like $1/g$ as g goes to infinity. On the other hand, the minimal asymptotic translation distance on the complex of curves for S_g behaves like $1/g^2$ as g goes to infinity. We describe a source of generating a sequence of pseudo-Anosov maps on S_g whose both invariants are small, i.e, the two invariants of the sequence behave like $1/g$ and $1/g^2$ respectively. This is a joint work with Hyunshik Shin (KAIST).

Yasushi Mizusawa (Nagoya Institute of Technology)
On pro-p link groups of number fields
As an analogue of a link group, we consider the Galois group of the maximal pro-p-extension of a number field with restricted ramification which is cyclotomically ramified at p, i.e, tamely ramified over the intermediate cyclotomic $\mathbb{Z}_p$-extension of the number field. In some basic cases, such a pro-p Galois group also has a Koch type presentation described by linking numbers and mod 2 Milnor numbers (Rédei symbols) of primes. Then the pro-2 Fox derivative yields a calculation of Iwasawa polynomials analogous to Alexander polynomials.

Masanori Morishita (Kyushu University)

Local symbols and the reciprocity law on foliated 3-manifolds
The theory of local symbols (Hilbert symbols, tame symbols) is a beautiful subject in number theory and algebraic geometry, and plays an important role in class field theory. In this talk, we introduce a local symbol on a foliated 3-manifold and show the reciprocity law. Our idea is to extend Deligne's interpretation of a tame symbol on a Riemann surface, by using Gomi-Terashima's higher dimensional holonomy of a smooth Deligne cocycle. Joint with Junhyeung Kim and Yuji Terashima.

Takefumi Nosaka (Kyushu University)
Massey products of free groups and Milnor-Orr link invariants.
TBA

Jinsung Park (KIAS)
Reidemeister torsion, complex volume, and Zograf infinite product
In this talk, I will explain a formula which expresses the Reidemeister torsion in terms of complex volume and Zograf infinite product for closed hyperbolic 3-manifold. This can be understood as an analogue of the corresponding formula of Zograf and McIntyre-Takhtajan for the regularized determinant of the hyperbolic Laplacian of compact Riemann surface.

Sakie Suzuki (Kyoto University, RIMS)
The universal quantum invariant and colored ideal triangulation
The Drinfeld double of a finite dimensional Hopf algebra is a quasi-triangular Hopf algebra with the canonical element as the universal R-matrix, and one can obtain a ribbon Hopf algebra by adding the ribbon element. The universal quantum invariant of framed links is constructed using a ribbon Hopf algebra. In that construction, a copy of the universal R-matrix is attached to each crossing, and invariance under the Reidemeister III move is shown by he quantum Yang-Baxter equation of the universal R-matrix. On the other hand, R. Kashaev showed that the Heisenberg double of a finite dimensional Hopf algebra has the canonical element (the S-tensor) satisfying the pentagon relation. In this talk we reconstruct the universal quantum invariant using the Heisenberg double, and extend it to an invariant for colored singular triangulations of topological spaces, especially for colored ideal triangulations of tangle complements. In this construction, a copy of the S-tensor is attached to each tetrahedron, and invariance under the colored Pachner (2; 3) moves is shown by the pentagon relation of the

S-tensor.

Megumi Takata (Kyushu University)
The infinite base change lifting associated to an APF extension of a mixed characteristic local field
Langlands conjectured that there is a nice correspondence between automorphic forms/representations and Galois representations of number fields. In the Langlands conjecture, the base change lifting is the counterpart on the automorphic side of the restriction functor on the Galois side. For a finite cyclic extension of a number field or a mixed characteristic local field, the lifting was constructed by Langlands for GL(2) and by Arthur-Clozel for GL(n). In this talk, we give such a lifting for a totally ramified $\mathbb{Z}_p$-extension of a mixed characteristic local field. By Kazhdan's theory of close fields, we can interpret this as an operation which maps an automorphic representation of GL(n) over a local field of mixed characteristic to that of positive characteristic.

Toshie Takata (Kyushu University)
The slope conjecture and periodic construction
The slope conjecture proposed by Garoufalidis asserts that the Jones slopes given by the sequence of degrees of the colored Jones polynomials are boundary slopes. We verify the slope conjecture for some non-adequate, periodic knots. This is a joint work with Kimihiko Motegi.

Shunsuke Tsuji (The University of Tokyo)
Construction of an invariant for integral homology spheres via Kauffman bracket skein algebras
Using an explicit formula for the action of the Dehn twist along a simple closed curve on the completed Kauffman bracket skein modules of the surface, we introduce an embedding of the Torelli group into the completed skein algebra. This embedding and a Heegaard splitting enable us to construct an invariant for an integral homology sphere which is an element of $\mathbb{Q}[[A+1]]$. This invariant induces a finite type invariant of order $n+1$ which is an element of $\mathbb{Q}[[A+1]]/((A+1)^n)$.

Jun Ueki (The University of Tokyo)
p-adic Mahler measure, entropy, and $\widehat{\mathbb{Z}}$-covers
My talk consists of two parts related to homology growth in $\mathbb{Z}$-covers of 3-manifolds. Let p be a fixed prime number.
(1) p-adic Mahler measure and $\mathbb{Z}$-covers of links.

An asymptotic formula of homology torsion growth with use of Mahler measure is well-known, and its p-adic refinement called the Iwasawa type formula is studied by Morishita and others. We introduce a p-adic analogue of Mahler measure imitating the Shnirel'man integral, and prove a p-adic analogue of the asymptotic formula. In addition, we give a balance formula among p-adic Mahler measure, Iwasawa mu-invariant, and Bowen's p-adic entropy.
(2) Profinite completions of knot groups determine Alexander polynomials.
It is interesting to ask what topological properties of knots are determined by the profinite completions of their knot groups; in other words, what the systems of finite quotients of knot groups know. By results of Hempel and Perelman, knot groups inject into their profinite completion. Grothendieck conjectured that such finitely generated groups would be determined by their profinite completions. However, counter examples were given by Bridson–Grunewald. We generalize results of Boileau–Friedl and Bridson–Reid by proving that the profinite completions of knot groups determine their Alexander polynomials. In the course of proof, we use Fried's theorem on cyclic resultant related to the Artin–Mazur zeta function of dynamical systems, and study modules over the completed group ring $\hat{\mathbb{Z}}[[t^{\hat{\mathbb{Z}}}]]$. Our method is suggested by a viewpoint of Arithmetic Topology.

Seidai Yasuda (Osaka University)
Ihara bracket for group schemes
TBA.

Low dimensional topology and number theory X

March 26 - 29, 2018
AiRIMaQ Seminar Rm, Innovation Plaza, Momochihama, Fukuoka, JAPAN

Program

March 26 (Monday)
9:30 ∼ 10:30
Thang Le (Georgia Institute of Technology)
The skein algebra of surfaces and hyperbolic TQFT

10:50 ∼ 11:50
Tsukasa Ishibashi (The University of Tokyo)
Cluster Dehn twists in cluster modular groups

14:00∼ 15:00
Makoto Sakuma (Hiroshima University)
On symmetries of knots

15:20 ∼ 16:20
Masanobu Kaneko (Kyushu University)
Genus character L-functions of quadratic orders and class numbers

March 27 (Tuesday)
9:30 ∼ 10:30
Hwajong Yoo (IBS, Center for Geometry and Physics, Postech)
Examples in arithmetic Chern-Simons theory

10:50 ∼ 11:50
Romyar Sharifi (University of California, Los Angeles)
Modular symbols and arithmetic

13:40 ∼ 14:40
Tomoki Mihara (Tokyo Institute of Technology)
Homotopy Theory for Metric Spaces

15:00 ∼ 16:00
Pavel Zalesskii (Universidade Brasilia)
The profinite colmpetion of 3-manifold groups

Banquet

March 28 (Wednesay)
9:30 ∼ 10:30
Takahiro Kitayama (The University of Tokyo)
Torsion polynomial functions and essential surfaces

10:50 ∼ 11:50
Jun Murakami (Waseda University)
On a q-deformation of PSL(2) representations of knot groups

14:00 ∼15:00
Yoshitaka Hachimori (Tokyo University of Science)
Functional equations and positively ramified extensions

15:20 ∼ 16:40
Zdzislaw Wojtkowiak (Universié de Nice)
TBA

March 29 (Thursday)
9:30 ∼ 10:30
Koichiro Sawada (RIMS, Kyoto University)
Finiteness of isomorphism classes of hyperbolic polycurves with prescribed fundamental groups

10:50 ∼ 11:50
Benjamin Collas (Universitat Bayreuth)
Arithmetics of Moduli Spaces of Curves and Topological Approaches

14:00 ∼ 15:00
Katsumi Ishikawa (RIMS, Kyoto University)
A link-homotopy invariant for surface links

15:20 ∼ 16:40
Kent Orr (Indiana University)
Transfinite 3-manifold invariants and a problem of John Milnor

Abstract

Benjamin Collas (Universitat Bayreuth)
Arithmetics of Moduli Spaces of Curves and Topological Approaches
The moduli stack of curves are endowed with two stratifications, a divisorial one induced by the Knudsen morphisms in the stable compactification, and a stack one induced by the automorphism of curves. They both encapture some remarkable arithmetical and combinatorial properties, which are the core of Grothendieck-Teichmüller theory, i.e. the study of the absolute Galois group of rational in terms of topology. The goal of this talk is to present how Grothendieck-Teichmüller theory – combined with group properties of the mapping class groups, and with homotopy properties of operads – leads to a better understanding of these arithmetics, as well as some promising research lines.

Yoshitaka Hachimori (Tokyo University of Science)
Functional equations and positively ramified extensions
We discuss functional equations of some elements in Iwasawa algebras, arising from the theory of positively ramified extensions which was developed by Alexander Schmidt.

Tsukasa Ishibashi (The University of Tokyo)
Cluster Dehn twists in cluster modular groups
A cluster modular group, which is introduced by Fock-Goncharov, is an automorphism group of a cluster algebra. The cluster modular group acts on a pair (A, X) of contractible manifolds called a cluster ensemble. These objects are associated with a combinatorial data called a seed. For the seed associated with an ideal triangulation of a punctured surface, it is known that cluster modular group=the (tagged) mapping class group, A = the decorated Teichmuller space, X = the enhanced Teichmuller space. Taking a suitable seed, we can also describe various objects: double Bruhat cells of algebraic groups, canonical bases of quantum groups, higher Teichmuller spaces, and so on. In this talk, we introduce the concept of "cluster Dehn twists" for a general cluster modular group, which is a generalization of Dehn twists and half-twists in the mapping class group of a surface. We show that orbits of the action of a cluster Dehn twist on the A-space have the similar asymptotic behavior as those of (half) Dehn twists. Moreover, for several seeds of finite mutation type, we show that the corresponding cluster modular group is generated by cluster Dehn twists. It is a generalization of the classical fact that the mapping class group of a surface is generated by

Dehn twists and half-twists.

Katsumi Ishikawa (RIMS, Kyoto University)
A link-homotopy invariant for surface links
A surface link is an oriented closed (not necessarily connected) surface smoothly embedded in the 4-sphere. Any 2-link, i.e. a surface link with all components being 2-spheres, is known to admit a link homotopy which pulls the 2-spheres apart, but we know only a little about homotopy classification of other surface links: for example, we have only a few link-homotopy invariants for them. In this talk, we introduce a link-homotopy invariant for surface links as a refinement of the asymmetric linking number. This is a surface-link version of Milnor's link-homotopy invariant for 1-links, and the triple linking number is calculated from it. This invariant works well for homotopy classification and the speaker expects it to detect the null-homotopy surface links.

Masanobu Kaneko (Kyushu University)
Genus character L-functions of quadratic orders and class numbers
For general quadratic orders, the genus character L-functions are explicitly computed. As an application, we generalize a formula due to Hirzebruch and Zagier which expresses the class number of imaginary quadratic fields in terms of continued fraction expansion. This is a joint work with Yoshinori Mizuno.

Takahiro Kitayama (The University of Tokyo)
Torsion polynomial functions and essential surfaces
We will discuss an application of torsion invariants to an extension of the Culler-Shalen construction of essential surfaces in a 3-manifold. The coefficients of twisted Alexander polynomials of a 3-manifold induce functions on its SL_n-character variety. We will describe how the homology class of an essential surface given by an ideal point is restricted by regularity of the function of the highest degree.

Thang Le (Georgia Institute of Technology)
The skein algebra of surfaces and hyperbolic TQFT
The skein algebra of surface has close relations to the character variety and the quantum Teichmüller space; it serves as a bridge between quantum topology and classical topology. We will discuss representations of the skein algebra and show how they can be used to potentially construct a hyperbolic TQFT.

Tomoki Mihara (Tokyo Institute of Technology)
Homotopy Theory for Metric Spaces
This is a joint work with Frederic Paugum. By a technique by Nikolai Durov, metric spaces are regarded as normed infinity groupoids. Using the identification, I formulate homotopy theory for metric spaces in terms of normed infinity category theory.

Jun Murakami (Waseda University)
On a q-deformation of PSL(2) representations of knot groups
In this talk, I would like to explain an idea to construct a q-deformation of PSL(2) representations of knot groups. The main tool is the braided quantum group BSL(2) constructed by S. Majid. The knot group is given by Wirtinger presentation, which is interpreted as a conjugate quandle. Here we construct a braided version of the conjugate quandle, and then associate the braided quantum group to the dual of the braided conjugate quandle., and then explain how the braided conjugate quandle relate to a knot diagram. This is joint with Roland van der Veen.

Kent Orr (Indiana University)
Transfinite 3-manifold invariants and a problem of John Milnor
In the mid-1950s, Milnor introduced his link invariants, a vast and profound extension of the classical the linking number. His examples, results, and a seminal list of problems have driven decades of research. One of Milnor's original questions remains unresolved. How can one extract a version of Milnor's invariants from the transfinite lower central series. We present a solution to this problem for 3-manifolds, developing transfinite invariants and realizing non-trival values.

Makoto Sakuma (Hiroshima University)
On symmetries of knots
After giving a quick survey on the study of symmetries of knots, I would like to talk about my joint work with Luisa Paoluzzi concerning amphicheirality and free periodicity of knots.

Koichiro Sawada (RIMS, Kyoto University)
Finiteness of isomorphism classes of hyperbolic polycurves with prescribed fundamental groups
A hyperbolic polycurve is a successive extension of families of hyperbolic

curves, which have been regarded as a typical example of "an anabelian variety". In other words, roughly speaking, a hyperbolic polycurve over a certain type of a field may be completely determined by its arithmetic fundamental group. In this talk, we show that a hyperbolic polycurve is determined by its arithmetic fundamental group up to finitely many possibilities.

Romyar Sharifi (University of California, Los Angeles)
Modular symbols and arithmetic
In this talk, I will explain a conjectural connection between modular symbols modulo an Eisenstein ideal and values of Steinberg symbols of cyclotomic units. I will then discuss recent developments in a program which has arisen from this.

Zdzislaw Wojtkowiak (Universié de Nice)
TBA

Hwajong Yoo (Universie de Nice)
Examples in arithmetic Chern-Simons theory
We introduce a basic idea behind of arithmetic Chern-Simons theory. Then, we compute the arithmetic Chern-Simons invariants in some cases using decomposition formula. As an application, we give a short proof of non-existence of certain quaternion extensions of the rational number field.

Pavel Zalesskii (Universidade Brasilia)
The profinite colmpetion of 3-manifold groups
We shall present structural results of the profinite completion $\widehat{G}$ of a 3-manifold group G and its interrelation with the structure of G. Residual properties of G also will be discussed.

Low dimensional topology and number theory XI

March 11 - 14, 2019
Conference Room E404, Science Building. E, Toyonaka Campus,
Osaka University, JAPAN

Program

March 11 (Monday)
10:00 ∼ 11:00
Ken Ono (Emory University)
Polya's Program for the Riemann Hypothesis and Related Problems

11:20 ∼ 12:20
Tomoyoshi Ibukiyama (Osaka University)
Graded rings of modular forms of rational weight

14:00 ∼15:00
Toshiki Matsusaka (Kyushu University)
A Kronecker limit type formula for hyperbolic Eisenstein series

15:20∼16:20
Anastasiia Tsvietkova (OIST)
Representations of knot groups

March 12 (Tuesday)
10:00 ∼ 11:00
Akira Sarashina (RIMS, Kyoto University)
Reconstruction of one-punctured elliptic curves in positive characteristic by their geometric fundamental groups

11:20 ∼ 12:20
Wataru Yuasa (Kyoto University)
Andrews-Gordon type identities for A_2 with one-row Young diagrams

14:00 ∼ 15:00
Masanobu Kaneko (Kyushu University)
On a variant of multiple zeta values of level two

15:20 ∼ 16:20
Madeline Dawsey (Emory University)
Higher Width Moonshine

17:15 ∼ Banquet

March 13 (Wednesay)
10:00 ∼ 11:00
Ian Wagner (Emory University)
Harmonic Hecke eigenlines and Mazur's problem

11:20 ∼ 12:20
Hikaru Hirano (Kyushu University)
On arithmetic Chern-Simons-Kim invariants for any number rings

14:00 ∼15:00
Hidekazu Furusho (Nagoya University)
Betti side of the double shuffle theory

15:20 ∼ 16:20
Jae Choon Cha (Postech)
Homotopical properties and freely slicing good boundary links

March 14 (Thursday)
10:00 ∼ 11:00
Jun Ueki (Tokyo Denki University)
Chebotarev link is stably generic

11:20 ∼ 12:20
Densuke Shiraishi (Osaka University)
Galois actions on fundamental groups of $\mathbb{P}^1\backslash\{0,1,\infty\}$ and triple ℓ-th power residue symbols

Abstract

Jae Choon Cha (Pohang University of Science and Technology)
Homotopical properties and freely slicing good boundary links
A question of fundamental importance in 4-dimensional topology is whether surgery works for arbitrary fundamental groups. It is known to be equivalent to the free slicing problem for certain class of links which are called good boundary links. We show that good boundary links satisfying a homotopically trivial plus property are freely slice. This generalizes all previously known methods for freely slicing good boundary links with two or more components, and presents new freely slice good boundary links.

Madeline Locus Dawsey (Emory University)
Higher Width Moonshine
Weak moonshine for a finite group G is the phenomenon where an infinite dimensional graded G-module

$$V_G = \bigoplus_{n \gg -\infty} V_G(n)$$

has the property that its trace functions, known as McKay-Thompson series, are modular functions. Recent work of Dehority, Gonzalez, Vafa, and Van Peski established that weak moonshine holds for every finite group. Since weak moonshine only relies on character tables, which are not isomorphism class invariants, non-isomorphic groups can have the same McKay-Thompson series. We address this problem by extending weak moonshine to arbitrary width $s \in \mathbb{Z}^+$. Namely, for each $1 \leq r \leq s$ and each irreducible character χ_i, we employ Frobenius' r-character extension $\chi_i^{(r)} : G^{(r)} \to \mathbb{C}$ to define McKay-Thompson series of $V_G^{(r)} := V_G \times \cdots \times V_G$ (r copies) for each r-tuple in $G^{(r)} := G \times \cdots \times G$ (r copies). These series are modular functions. We find that *complete* width 3 weak moonshine always determines a group up to isomorphism. Furthermore, we establish orthogonality relations for the Frobenius r-characters, which dictate the compatibility of the extension of weak moonshine for V_G to width s weak moonshine.

Hidekazu Furusho (Nagoya University)
Betti side of the double shuffle theory
This is on my joint work with Benjamin Enriquez. The double shuffle relation is one of the most important algebraic relations among multiple zeta values. In 2002, Racinet gave its nice description by using certain

Hopf algebras constructed from the de Rham fundamental group of the projective line minus three points. My talk is on its Betti counterpart of his work. I will introduce a new coproduct on a Hopf algebra constructed from the Betti fundamental group and by using this I will explain how the double shuffle relation follows from the associator relation. The proof relies on an interpretation of the harmonic coproduct in terms of infinitesimal braid Lie algebras, which is implicit in the unpublished work of Deligne and Terasoma from 2005.

Hikaru Hirano (Kyushu University)
On arithmetic Chern-Simons-Kim invariants for any number rings
Recently, Minhyong Kim introduced the notion of arithmetic Chern- Simons invariants for totally imaginary number fields, which is based on analogies with Dijkgraaf-Witten theory for 3-manifolds. In this lecture, I will extend Kim's invariants for any number fields, using modified étale cohomology which takes real places into account, and then calculate abelian Chern-Simons-Kim invariants concretely for certain real quadratic number fileds.

Tomoyoshi Ibukiyama (Osaka University)
Graded rings of modular forms of rational weight
We construct a system of modular forms of one variable of rational weight belonging to $\Gamma(N)$ and write the automorphy factor explicitly. Then we consider the graded rings of modular forms of integral multiples of that weight and ask if the forms we constructed give generators of the ring. We show that the answer is yes for small N by using Mumford criterion of normal generation, and give fundamental relations of the generators for such N.

Masanobu Kaneko (Kyushu University)
On a variant of multiple zeta values of level two
We introduce and discuss a variant of multiple zeta values of level 2, which forms a subspace of the space of alternating multiple zeta values. This variant exhibits nice properties such as duality, shuffle product, parity results like ordinary multiple zeta values. We give some conjectures on relations between our values and ordinary multiple zeta values.

Toshiki Matsusaka (Kyushu University)
A Kronecker limit type formula for hyperbolic Eisenstein series
In 1979, Kudla and Millson introduced a form-valued hyperbolic Eisen-

stein series associated to any closed geodesic on the Riemann surface $\Gamma\backslash\mathfrak{H}$. More recently, Jorgenson, Kramer, and Pippich in 2010 defined a scalar-valued analog of the hyperbolic Eisenstein series, and established the meromorphic continuation to the whole s-plane. As in the classical parabolic case, they studied the Laurent expansion at the special point $s = 0$. In the particular case of $\Gamma = \mathrm{SL}_2(\mathbb{Z})$, this Eisenstein series has double zero at $s = 0$. In this talk, we give the second order coefficient explicitly.

Ken Ono (Emory University)
Polya's Program for the Riemann Hypothesis and Related Problems
In 1927 Polya proved that the Riemann Hypothesis is equivalent to the hyperbolicity of Jensen polynomials for Riemann's Xi-function. This hyperbolicity has only been proved for degrees d=1, 2, 3. For each d we prove the hyperbolicity of all but (perhaps) finitely many Jensen polynomials. We obtain a general theorem which models such polynomials by Hermite polynomials. This theorem also allows us to prove a conjecture of Chen, Jia, and Wang on the partition function. This result can be thought of as a proof of GUE for the Riemann zeta function in derivative aspect. This is joint work with Michael Griffin, Larry Rolen, and Don Zagier.

Akira Sarashina (RIMS, Kyoto University)
Reconstruction of one-punctured elliptic curves in positive characteristic by their geometric fundamental groups
The principal theme for anabelian geometry is the reconstruction of the geometry of algebraic varieties by their étale fundamental groups. By G.A.G.A. theorems, the isomorphism class of the étale fundamental group of a curve over an algebraically closed field of characteristic 0 is determined by the genus and the cardinality of cusps. But that of a curve over an algebraically closed field of positive characteristic is not determined by easy invariants. In other words, it has much information. Tamagawa proved that the isomorphism class as a scheme of curves over $\overline{\mathbb{F}}_p$ can be reconstructed by their étale fundamental groups when the genus is 0. In this talk, we will discuss the genus 1 case, and prove a similar result when the genus is 1, the cardinality of cusps is 1 and the characteristic is not equal to 2.

Densuke Shiraishi (Osaka University)
Galois actions on fundamental groups of $\mathbb{P}^1\backslash\{0, 1, \infty\}$ and triple ℓ-th

power residue symbols
In this talk, we discuss relationships between ℓ-adic Galois polylogarithms and triple ℓ-th power residue symbols in some special cases studied by a recent work of Hirano-Morishita. We show that a functional equation of ℓ-adic Galois polylogarithm by Nakamura-Wojtkowiak implies a reciprocity law of triple ℓ-th power residue symbol.

Anastasiia Tsvietkova (Okinawa Institute of Science and Technology)
Representations of knot groups
We describe a new method of producing equations for the representation variety of a knot group into (P)SL(2,C). Unlike known methods, this does not involve any polyhedral decomposition or triangulation of the link complement, and uses only a link diagram satisfying a few mild restrictions. This results in a simple algorithm that can often be performed by hand, and in many cases, for an infinite family of knots at once. This is a joint work with Kathleen Peterson, based on an earlier joint work with Morwen Thislethwaite. The discrete faithful representation gives rise to the invariant trace field, which is a topological and commensurability invariant. We will also show how these ideas allow to compute the field exactly and from a link diagram. This is an earlier joint work with Walter Neumann.

Jun Ueki (Tokyo Denki University)
Chebotarev link is stably generic
When we study the analogy between knots and prime numbers in "arithmetic topology", it is a fundamental question to ask "what is the analogue of the set of all prime ideals of a number field in a 3-manifold?" In [NiiboUeki2018], the speaker constructed a "very admissible link" as a candidate in a 3-manifold, and described the idelic class field theory by summing up local theories to describe the global theory. Afterwards, Mihara gave a cohomological interpretation on it, and proposed a "stably generic link" refining our link so that we can study analogues of ray class fields in [Mihara2018]. On the other hand, McMullen proved in [McMullen2013] that the closed orbits of a pseudo-Anosov flow on a 3-manifold obeys the Chebotarev law in the sense of B. Mazur [Mazur2012], if ordered by length. For instance, the planetary link of the figure eight knot (or the Whitehead link or the Borromean rings) obeys the Chebotarev law, by Thurston's classification theorem. In addition, this infinite link contains all isotopy classes of links, due to the theory of universal template [Ghrist1993]. In this talk, we compare

these infinite links and prove that Chebotarev link is stably generic. In addition, as an example of Chebotarev phenomena, we study the decomposition types of knots in an analogue of a quintic field.

Ian Wagner (Emory University)
Harmonic Hecke eigenlines and Mazur's problem

We construct two families of harmonic Maass Hecke eigenforms. Using these families, we construct p-adic harmonic Maass forms in the sense of Serre. The p-adic properties of these forms answer a question of Mazur about the existence of an " eigencurve-type " object in the world of harmonic Maass forms.

Wataru Yuasa (Kyoto Univeristy)
Andrews-Gordon type identities for A_2 with one-row Young diagrams
In this talk, we derive Andrews-Gordon type identities for the $\mathfrak{sl}_3$ (false) theta functions via knot theory. The $\mathfrak{sl}_3$ tail of a link L is a limit of the $\mathfrak{sl}_3$ colored Jones polynomials $\{J_\lambda^{\mathfrak{sl}_3}(L)\}_{\lambda\in\Lambda}$ for Λ is a certain subset of two-row Young diagrams. For one-row Young diagrams $\Lambda = \{(n,0)\}$, we calculate two types of explicit formulae of $J_\lambda^{\mathfrak{sl}_3}(T(2,m))$ where $T(2,m)$ is a $(2,m)$-torus link and obtain two explicit formulae of its tail. They give the Andrews-Gordon type identities for Ramanujan (false) theta functions.

Low dimensional topology and number theory XIII

To the memory of Professor Toshie Takata

IMI Auditorium (413 Rm), 4F West 1st Bd, Kyushu University (Ito Campus) 15th March, 2022 ? 18th March, 2022

Program

March 15th (Tues)
9:40 Organizer

9:45 – 9:55
Osamu Saeki（Kyushu University, IMI)

10:00 – 11:00
Michihisa Wakui（Kansai University）
A new algorithm of the normalized Jones polynomials of rational links

11:20–12:20
Kimihiko Motegi（Nihon University） Online
The Strong Slope Conjecture for Mazur pattern satellite knots

14:00 – 15:00
Toshitake Kohno（Meiji University/The University of Tokyo) Online
Temperley-Lieb-Jones category and the space of conformal blocks

15:20 – 16:40 To the memory of Professor Toshie Takata:
Haruko Takayama (Nishi)（Josai University) Online
Tomoyoshi Ibukiyama (Osaka University) Online
and some others

17:00 – 18:00
Christian Kassel（Université de Strasbourg/CNRS） Online
Braid groups and Steinberg groups

March 16th (Wedes)
10:00 – 11:00
Jun Murakami（Waseda University）
Volume potential function and its applications

11:20 – 12:20
Yoshiyuki Yokota（Tokyo Metropolitan University）
On Neumann-Zagier matrices and generalized angle structures for hyperbolic knots

14:00 – 15:00
Kazuo Habiro（Kyoto University）
Ribbon Yetter-Drinfeld modules and tangle invariants

15:20 – 16:20 To the memory of Professor Toshie Takata:
Sakie Suzuki（Tokyo Institute of Technology) Online
and some others

16:40 – 17:40
Hitoshi Murakami（Tohoku University） Online
The colored Jones polynomial of the figure-eight knot

March 17th (Thurs)
10:00 – 11:00
Eiko Kin（Osaka University）
Braids and fibered double branched covers of 3-manifolds

11:20 – 12:20
Hidekazu Furusho（Nagoya University）
Kashiwara-Vergne Lie algebra and Goncharov's dihedral Lie algebra in mould theory

14:00 – 15:00
Hisatoshi Kodani（Tohoku University） Online
On partial generalization of Hodge correlators associated with diagrams allowed to have loops

15:20 – 15:50
Densuke Shiraishi（Osaka University）
On functional equations of ℓ-adic Galois polylogarithms

16:10 – 16:40
Hikaru Hirano（Kyushu University）
Brylinski-McLaughlin's state space and its arithmetic analogue

March 18th (Fri)
10:00 – 11:00
Hiroyuki Ochiai (Kyushu University, IMI)
On arithmetic-geometric means and hypergeometric functions contained in Gauss' Werke

11:20 – 12:20
Takeo Uramoto (Kyushu University, IMI)
Classical class field theory meets algebraic language theory

14:00 – 14:30
Ryoto Tange (Waseda University) Online
On adjoint homological Selmer modules for SL(2)-representations of knot groups

14:50 – 15:20
Hyuga Yoshizaki (Tokyo University of Science) Online
Weber's class number problem for cyclic covers of knots

15:40 – 16:40
Toshiki Matsusaka (Nagoya University)
Modular transformations of homological blocks for Seifert fibered homology 3-spheres

Abstract

March 15th (Tues)
Michihisa Wakui (Kansai University)
A new algorithm of the normalized Jones polynomials of rational links

In connection with cluster algebras, snake graphs and q-integers, Kyungyong Lee and Ralf Schiffler recently found a formula for computing the (normalized) Jones polynomials of rational links in terms of continued fraction expansion of rational numbers. Sophie Morier-Genoud and Valentin Ovsienko introduced q-deformed continued fractions, and showed that by using them each coefficient of the normalized Jones polynomial counted quiver representations of type An. In this talk we introduce q-deformed integers defined by coprime pairs of natural numbers, which are motivated by the denominators and the numerators of their q-deformed continued fractions, and give an efficient algorithm for computing the normalized Jones polynomials of rational links.

Kimihiko Motegi (Nihon University)
The Strong Slope Conjecture for Mazur pattern satellite knots

The Slope Conjecture proposed by Garoufalidis asserts that the degree of the colored Jones polynomial determines a boundary slope, and its refinement, the Strong Slope Conjecture proposed by Kalfagianni and Tran asserts that the linear term in the degree determines the topology of an essential surface that satisfies the Slope Conjecture. Under certain hypotheses, we show that a Mazur pattern satellite knots satisfy the Strong Slope Conjecture if the original knot does. Consequently, combining with previous results, any knot obtained by a finite sequence of cabling, connected sums, Whitehead doubling and taking Mazur pattern satellites of adequate knots (including alternating knots) or torus knots satisfies the Strong Slope Conjecture. This is joint work with Kenneth L. Baker (University of Miami) and Toshie Takata.

Toshitake Kohno (Meiji University/The University of Tokyo)
Temperley-Lieb-Jones category and the space of conformal blocks

We show that the set of morphisms of the colored Temperley-Lieb-Jones category at roots of unity is isomorphic to the space of conformal blocks in the Wess-Zumino-Witten conformal field theory. We describe the

braid group action on these spaces and explain that the above isomorphism is equivariant and that the representations are unitary and irreducible. To prove this we use an expression of the space of conformal blocks by multi-dimensional hypergeometric integrals. This investigation leads us to reveal a family of unitary and irreducible representations of the braid groups contained in homological representations at roots of unity.

Christian Kassel (Université de Strasbourg/CNRS)
Braid groups and Steinberg groups

We construct a homomorphism from the braid group on $2n+2$ strands to the Steinberg group associated with the Lie type Cn and with integer coefficients. This homomorphism lifts the well-known symplectic representation of the braid groups. We shall describe its image, expressing it in terms of the level 2 congruence subgroup of the symplectic modular group. We shall also determine its kernel. This is joint work with Francois Digne (Amiens).

March 16th (Wedes)
Jun Murakami (Waseda University)

Volume potential function and its applications The volume potential function appears as a certain limit of the colored Jones polynomial in the study of the volume conjecture. This volume potential function is conjectured to relate the A-polynomial and the twisted Reidemeister torsion. The relation to the A-polynomial is studied as AJ-conjecture, and the relation to the twisted Reidemeister torsion is conjectured by Gkukov-H.Murakami and is proved for two-bridge knots by Ohtsuki-Takata. In this talk, such relations are explained for twisted Whitehead links and some other examples. This is a joint with A. Tran.

Yoshiyuki Yokota (Tokyo Metropolitan University)
On Neumann-Zagier matrices and generalized angle structures for hyperbolic knots

We first review the simplectic property of the Neumann-Zagier matrix obtained from an ideal triangulation of a hyperbolic knot complement M. We then give a nice parametrization of the generalized angle structures, assignments of real numbers to the pairs of opposite edges of the

tetrahedra, of M, and show that the volume of M is given by a critical value of the volume functional defined on such parametrized space.

Kazuo Habiro (Kyoto University)
Ribbon Yetter-Drinfeld modules and tangle invariants

It is well known that finite-dimensional Yetter-Drinfeld modules over a Hopf algebra form a braided, pivotal category, but not necessarily a ribbon category. We introduce a notion of ribbon Yetter-Drinfeld modules and show that finite-dimensional ribbon Yetter-Drinfeld modules form a ribbon category, and therefore give rise to tangle invariants. This is joint work with Yuka Kotorii.

Hitoshi Murakami (Tohoku University)
The colored Jones polynomial of the figure-eight knot

For any positive integer N, the colored Jones polynomial of a knot gives a Laurent polynomial in q. When we replace q with $\exp(u/N)$ for a fixed complex number u, we have a function $f_u(N)$ from positive integers to complex numbers. I will talk about relations between the asymptotic behaviors of $f_u(N)$ of the figure-eight knot for various u, and representations of the fundamental group of the knot complement to SL(2; $\mathbb{C}$). Part of this work is a joint work with Anh Tran.

March 17th (Thurs)
Eiko Kin (Osaka University)

Braids and fibered double branched covers of 3-manifolds

The branched virtual fibering theorem by Sakuma states that every closed orientable 3-manifold M with a Heegaard surface of genus g has a branched double cover which is a genus g surface bundle over the circle. It is proved by Brooks that such a surface bundle can be chosen to be hyperbolic. In a previous result with Susumu Hirose, we proved that when M is the 3-sphere S^3, the minimal entropy over all hyperbolic, genus g surface bundles as branched double covers of S^3 behaves like $1/g$. In this talk, I will explain that infinitely many closed 3-manifolds have the same property. To prove this claim, we use an alternative construction of surface bundles in Sakuma's theorem when M is a branched double cover of S^3 branched over a link. A feature of surface bundles

coming from our construction is that the monodromies can be read off the braids obtained from the links as the branched set. This is a joint work with Susumu Hirose.

Hidekazu Furusho (Nagoya University)

Kashiwara-Vergne Lie algebra and Goncharov ' s dihedral Lie algebra in mould theory

We introduce the Kashiwara-Vergne bigraded Lie algebra associated with a finite abelian group. By giving its mould theoretic interpretation, we show that it includes the Goncharov ' s dihedral Lie algebra, which generalizes the result of Raphael and Schneps. It is a joint work with Nao Komiyama.

Hisatoshi Kodani (Tohoku University)

On partial generalization of Hodge correlators associated with diagrams allowed to have loops

Goncharov's Hodge correlators are complex numbers given as certain integrals assigned to Riemann surfaces. They contain a wide variety of arithmetic invariants such as classical (elliptic) polylogarithms and special values of some L-functions, and provide an alternative way to describe the standard real mixed Hodge structure on the nilpotent completion of the fundamental group of a punctured Riemann surface given by Chen's iterated integral. As he showed, the Hodge correlators can be thought of as tree diagrams part of large N asymptotic expansion of a matrix model. However, the structure and properties of loop diagrams part was left as problem and has been still unknown, since the loop part could be divergent. In this talk, we explain a partial generalization of Hodge correlators associated with diagrams allowed to have loops and their several propeties. This talk is based on a joint work with Y. Terashima.

Densuke Shiraishi (Osaka University)
On functional equations of ?-adic Galois polylogarithms

The ℓ-adic Galois polylogarithm is an arithmetic function on the absolute Galois group with values in ℓ-adic numbers, which is defined as

a certain coefficient of the ℓ-adic associator arising from the Galois action on the etale fundamental groupoid of the projective line minus three points. This function was introduced by Wojtkowiak as an ℓ-adic Galois analogue of the classical polylogarithm, and typical functional equations of ℓ-adic Galois dilogarithms are proved by Nakamura and Wojtkowiak. In this talk, we discuss some new functional equations for ℓ-adic Galois polylogarithms that are not found in previous works.

Hikaru Hirano (Kyushu University)
Brylinski-McLaughlin ' s state space and its arithmetic analogue

Brylinski and McLaughlin introduced a certain state space as a variant of the space of conformal blocks in (2+1)-dim Dijkgraaf-Witten TQFT, and posed a question on their space. We give an answer to it and study an arithmetic analogue of the state space.

March 18th（Fri）
Hiroyuki Ochiai（Kyushu University, IMI）

On arithmetic-geometric means and hypergeometric functions contained in Gauss' Werke

There are contained some numerical examples of arithmetic-geometric means in Gauss' Werke. I will talk about my discovery on those numerical values. It is known that arithmetic-geometric means can be expressed by the special values of hypergeometric functions. I will also talk about my observation on some family of special functions related to those hypergeometric functions.

Takeo Uramoto（Kyushu University, IMI）
Classical class field theory meets algebraic language theory

Algebraic language theory is a subfield of the theory of computation, and since the 1960s, has developed semigroup-theoretic methodology for solving several logical/combinatorial decision problems concerning regular languages (= sets of finite words accepted by finite automata). In our recent works, we observed that algebraic language theory can be unified with galois theory in a certain precise categorical sense, and more importantly, that this unification sheds a new light on classical class field theory and complex multiplication. In this talk, we will overview these

recent results and discuss some future perspective.

Ryoto Tange (Waseda University)
On adjoint homological Selmer modules for SL(2)-representations of knot groups

We introduce the adjoint homological Selmer module for an SL(2)-representation of a knot group, which may be seen as an analogue of the adjoint Selmer module for a Galois representation in number theory. This is joint work with Takahiro Kitayama, Masanori Morishita, and Yuji Terashima.

Hyuga Yoshizaki (Tokyo University of Science)
Weber's class number problem for cyclic covers of knots

We study an analogue of Weber's class number problem for cyclic covers of knots in the spirit of arithmetic topology. Let p be a prime number. Webers problem is an unsolved problem with a long history in number theory asking the class numbers of certain cyclic p^n-th extensions of the rationals $\mathbb{Q}$. Since the analogue of the class numbers of number fields is the sizes of the first homology groups of 3-manifolds, we study the sizes of the first homology groups of cyclic p^n-th covers of knots in S^3. In number theory side, the speaker previously proved the p-adic convergence of the class numbers, but their limit value is not yet known for any example. In this talk, on the other hand, we prove an analogous result in knot theory side and concretely calculate their limit for the torus knots and the twist knots. This talk is based on a joint work with Jun Ueki (Tokyo Denki University).

Toshiki Matsusaka (Nagoya University)
Modular transformations of homological blocks for Seifert fibered homology 3-spheres

Recently, Gukov-Pei-Putrov-Vafa introduced q-series-valued invariants called homological blocks for any plumbed 3-manifolds. In this talk, for any Seifert fibered homology 3-sphere, we give modular transformation formulas of homological blocks. Moreover, based on the modular transformation formulas, we have explicit asymptotic expansion formulas for the Witten-ReshetikhinTuraev invariants, which give a new proof of a version by Andersen of the Witten asymptotic conjecture. This is joint

work with Yuji Terashima (Tohoku University).

Low dimensional topology and number theory XIV

IMI Auditorium (413 Rm), 4F West 1st Bd, Kyushu University (Ito Campus)
27th March, 2023 $\sim$ 30th March, 2023

Program

March 27th (Mon)
9:30 – 10:30
Jun Ueki（Ochanomizu University）
Non-acyclic SL_2-representations, surgeries, and L-functions of the twisted Whitehead links

10:50 – 11:50
Sohei Tateno（Nagoya University）
The Iwasawa invariants of $\mathbb{Z}_p^d$-covers of links

13:40 – 14:40
Takefumi Nosaka（Tokyo Institute of Technology）
Reciprocity of the Chern-Simons invariants of 3-manifolds

March 28th (Tues)
9:30 – 10:30
Naganori Yamaguchi（RIMS, Kyoto University）
On the development of anabelian geometry using the maximal geometrically m-step solvable quotient of arithmetic fundamental groups

10:50 – 11:50
Shun Ishii（RIMS, Kyoto University）
On pro-p outer Galois representations associated to once-punctured CM elliptic curves

13:40 – 14:40
Takeo Uramoto（IMI, Kyushu University）
On the modularity theorem for algebraic Witt vectors

15:00 – 16:00
James Borger (Australian National University)
Report on scheme theory over semirings

March 29th (Wednes)
9:30 – 10:30
Yosuke Morita (Kyoto University)
A new framework for Conley index theory

10:50 – 11:50
Jonathan Beardsley (University of Nevada)
Toward Higher Algebra Over $\mathbb{F}_1$

13:40 – 14:40
Takuya Takeishi (Kyoto Institute of Technology)
Rigidity theorems of C*-algebras arising from number theory

15:00 – 16:00
Takeshi Shinohara and Nao Komiyama (Nagoya University)
Shuffle product of desingularized multiple zeta functions at integer points

March 30th (Thurs)
10:00 – 11:00
Atsushi Katsuda (Kyushu University)
Closed geodesics, Heat kernels and Hofstadter butterfly

13:00 – 14:00
Jesus Ántonio Alvarz López (Universidade de Santiago de Compostela)
A trace formula for foliated flows

14:20 – 15:20
Dohyeong Kim (Seoul National University)
Iwasawa's invariant and its Diophantine application

Abstract

• Jesús A. Álvarez López (University of Santiago de Compostela)

A trace formula for foliated flows

Let $(M, \mathcal{F}, \phi^t)$ be a smooth compact manifold equipped with codimension one foliation and a foliated flow (the flow maps leaves to leaves). Assume ϕ^t has simple closed orbits and transversely simple preserved leaves. Then there are finitely many leaves preserved by the flow, whose union is a compact submanifold M^0, and a precise description of the transverse structure of $\mathcal{F}$ can be given. The distributional leafwise differential forms conormal to M^0 form a complex with the de Rham derivative of the leaves, giving rise to the conormal leafwise reduced cohomology $\bar{H}I(\mathcal{F})$. We define a Leftchetz distribution $L_{\mathrm{dis}}(\phi^t)$ on $\mathbb{R}$ of the induced action ϕ^{t*} on $\bar{H}I(\mathcal{F})$. Then we prove a distributional Lefschetz trace formula describing $L_{\mathrm{dis}}(\phi^t)$ in terms of infinitesimal data of the closed orbits and preserved leaves. This kind of distributional trace formula was conjectured by Christopher Deninger, motivated by possible arithmetic interpretations. In the case where $M^0 = \emptyset$ (when $\mathcal{F}$ is Riemannian), this formula was proved using smooth leafwise differential forms. This is joint work with Yuri Kordyukov and Eric Leichtnam.

• Jonathan Beardsley (University of Nevada)

Toward Higher Algebra Over $\mathbb{F}_1$

Abstract: In a series of papers, Alain Connes and Caterina Consani have introduced a framework for doing "algebra in characteristic one." Their approach has strong connections to Segal's approach to stable homotopy theory via so-called Γ-spaces. I will describe some first steps in further developing this analogy. In particular I will show that within their framework there is a natural notion of the "classifying space" of an $\mathbb{F}_1$-module. If A is the $\mathbb{F}_1$-module associated to an abelian group, commutative monoid, or abelian hypergroup, with classifying space BA, then taking the loop space of BA (for a slightly non-standard notion of loop space described by Connes and Consani) recovers A. This suggests that higher deloopings and possibly Eilenberg-MacLane spectra of $\mathbb{F}_1$-modules may be possible, though they would require working with a suitable model for (∞,∞)-categories. This is joint work with Joe Moeller.

• James Borger (Australian National University)

Report on scheme theory over semirings

Usually in algebraic geometry, one works with schemes defined over base fields. But for arithmetic applications, where transferring information between positive characteristic and characteristic zero is necessary, it's convenient to work with schemes defined over base rings, such as the integers or the p-adic integers. Indeed, since this formalism became available in the mid-20th century, it has become standard.

It is however possible to go even deeper and set up scheme theory over any base semiring. This includes objects like projective space over the nonnegative reals, the Boolean numbers, or the natural numbers, which is the deepest subring of all. Doing so allows us to preserve positivity information in the underlying theory, much as the passage from base fields to base rings allowed for the preservation of integrality information.

Scheme theory over semirings is however in its infancy. In this talk, I'll report on some areas of scheme theory over rings which have been recently extended to semirings, such as the etale fundamental group (joint with Robert Culling) and the Picard stack (joint with Jaiung Jun). One notable point that came out of the latter work is that the various familiar definitions of vector bundle in scheme theory over rings do not remain equivalent over semirings but that all the familiar definitions of line bundle do remain equivalent.

• Shun Ishii (RIMS, Kyoto University)

On pro-p outer Galois representations associated to once-punctured CM elliptic curves

Let p be an odd prime. Sharifi proved that, under the Deligne-Ihara conjecture (now a theorem of Brown), the kernel of the pro-p outer Galois representation associated to the thrice-punctured projective line corresponds to the maximal pro-p extension of $\mathbb{Q}(\mu_p)$ unramified outside p if p is regular. In this talk, we discuss an analogue of his result for imaginary quadratic fields by considering once-punctured CM elliptic curves instead of the thrice-punctured projective line.

• Atsushi Katsuda (Kyushu University)

Closed geodesics, Heat kernels and Hofstadter butterfly

The Bloch-Floquet theory are popular tools for the investigation of materials with periodic structures. For example, we can show that the spectrum of periodic Schrödinger operators have band structures. In

the context of this talk, this theory was applied to the following problems in the case of abelian extensions:

(1) A geometric analogue of the Chebotarev density theorem for prime closed geodesics in a compact Riemannian manifold with negative curvature

(2) A long time asymptotic expansion of the heat kernels of covering manifolds of compact Riemannian manifolds.

Here, we shall extend the above results by applying our version of the Bloch-Floquet theory for the Heisenberg group, which is the simplest, but non-trivial non-abelian infinite group. Our method is based on a combination of the representation theory for discrete Heisenberg groups especially due to Pytlik and that of the Heisenberg Lie group.

Moreover, there is a relation to the our methods for the Heisenberg group and the analysis of the discrete magnetic Laplacian or the Harper operator on the square lattice $\mathbb{Z}^2$. Spectrum of the latter operators are expressed by the celebrated Hofstadter butterfly as the following figure:

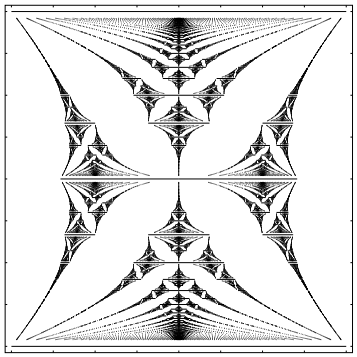

Figure 1: the Hofstadter's butterfly (created by Hisashi Naito).

Especially, our arguments give an another mathematical justification of semi-classical asymptotic expansion formula for spectrum of the Harper operator due to Wilkinson, which is originally done by Helffer-Sjöstrand.

$$E_n = -4 + (2n+1)\theta + O(\theta^2) \qquad n = 0, 1, 2, \dots l$$

If time permits, I shall explain generalizations of our method to more general nilpotent groups and further applications.

• Dohyeong Kim (Seoul National University)

Iwasawa's invariant and its Diophantine application

We review the cyclotomic Iwasawa theory and apply the vanishing of the mu-invariant to some Diophantine problems. I will compare the vanishing of mu-invariants to the monicity of twisted Alexander polynomials.

• Nao Komiyama, Takeshi Shinohara (Nagoya University)

Shuffle product of desingularized multiple zeta functions at integer points

We show that the "shuffle-type" formula holds for special values of desingularized multiple zeta functions at any integer points. This is proven by giving an iterated/differential expression for the special values at integer points of the desingularized multiple zeta functions. We explain how the so-called renormalization method is applied in our proof.

• Yosuke Morita (kyoto University)

A new framework for Conley index theory

The Conley index is, informally speaking, a 'space' that describes the local dynamics around an isolated invariant subset of a topological dynamical system. It can be seen as a spatial refinement of the Morse index and is used, for instance, in Manolescu ' s construction of the Seiberg-Witten-Floer homotopy type. In this talk, I will explain a new framework for Conley index theory, which I think is simpler and more flexible than the traditional formulation. One important point is that the Conley index should be defined as a based equivariant ind-(compact Hausdorff space) (or slightly more generally, a based equivariant condensed set/anima), not as a mere homotopy type of topological spaces.

• Takefumi Nosaka (Tokyo Institute of Technology)

Reciprocity of the Chern-Simons invariants of 3-manifolds

Given an oriented closed 3-manifold M and a representation $\pi_1(M) \longrightarrow SL_2(\mathbb{C})$, we can define the Chern-Simons invariant and adjoint Reidemeister torsion. Recently, several physicists and topologists pose and study reciprocity conjectures of the torsions. Analogously, I posed reciprocity conjectures of the Chern-Simons invariants of 3-manifolds, and discussed some supporting evidence on the conjectures. Especially, I showed that the conjectures hold if Galois descent of a certain K_3-group is satisfied. In this talk, I will explain the background and the results

in detail.

• Takuya Takeishi (Kyoto Institute of Technology)

Rigidity theorems of C*-algebras arising from number theory

C*-algebras can be constructed from various mathematical objects, and it is commonly interested to detect what kind of information is preserved by taking C*-algebras. Usually, a lot of information may vanish, but it turned out that several classes of C*-algebras constructed from number fields remember the original number fields completely. As a consequence, we can construct several classes of countable (noncommutative) groups which are complete invariants of number fields. In this talk, we explain the speaker's recent contribution to the study of this phenomenon, together with several related results.

• Sohei Tateno (Nagoya University)

The Iwasawa invariants of $\mathbb{Z}_p^d$-covers of links

In this talk, we will define the Iwasawa invariants of links and give two asymptotic formulae for the first homology groups of $\mathbb{Z}_p^d$-covers of links in rational homology 3-spheres, which are generalizations of the Iwasawa type formulae proven by Hillman-Matei-Morishita and Kadokami-Mizusawa. We will also provide examples of these formulae. Moreover, when $d = 2$, considering the twisted Whitehead links, we will explain that Iwasawa μ-invariants can be arbitrary non-negative integers. This is a joint work with Jun Ueki.

• Jun Ueki (Ochanomizu University)

Non-acyclic SL_2-representations, surgeries, and L-functions of the twisted Whitehead links

We study the zeros of the SL_2-acyclic torsion functions τ of links. We first study that of the Whitehead link W_1 and deduce results for twist knots simultaneously. Next, we extend the study to every twisted Whitehead link W_k with $k \in \mathbb{Z}$ and prove that the zeros of τ have the multiplicity two on the geometric component of the character variety. Finally, we paraphrase the notion of multiplicity of common zeros and investigate the L-functions of the universal deformations of residual representations of W_k. (Based on a joint work with Leo Benard, Ryoto Tange, and Anh Tran.)

• Takeo Uramoto (IMI, Kyushu University)

On the modularity theorem for algebraic Witt vectors

In my previous work, I proved the (weak/strong) "modularity theorem for algebraic Witt vectors" over imaginary quadratic fields K, the strong one of which claims that they are precisely those generated over K by modular vectors whose coefficients are special values of deformation family of Fricke modular functions. Arithmetically this construction implies, say, congruences between special values of modular functions living at different levels (rather, not necessarily galois-conjugate ones), and provides natural re-interpretations of classical objects (say, Fricke functions, Witt vectors) in class field theory and the theory of complex multiplication, albeit it yet seems to be a special facet of some more general theme of deformation theory. In view of this, I would like to devote this talk to some clarification/discussion on more generic geometric structures behind this specific phenomenon, extending it to the case of CM fields in particular.

• Naganori Yamaguchi (RIMS, Kyoto University)

On the development of anabelian geometry using the maximal geometrically m-step solvable quotient of arithmetic fundamental groups

In anabelian geometry, we have the following conjecture called the Grothendieck conjecture: The geometric information of hyperbolic curves is reconstructed group-theoretically from their arithmetic fundamental groups. This conjecture was proved by Hiroaki Nakamura, Akio Tamagawa, and Shinichi Mochizuki. However, many unresolved problems still remain around this conjecture. One of these problems is the main topic of this talk which is called the m-step solvable Grotheindieck conjecture, specifically: The geometric information of hyperbolic curves is reconstructed group-theoretically from the maximal geometrically m-step solvable quotient of their arithmetic fundamental groups. In this talk, we will present about this conjecture and a part of its proof by the speaker.