A Partial List of ABSTRACTS

Dror **Bar-Natan**, drorbn@math.toronto.edu

The Grothendieck-Teichmüller group and knot theory

My lecture plans will be roughly as follows:

Talk I:

1. Knotted Trivalent Graphs (KTGs) and their finite type invariants.
2. Operations on KTGs and the corresponding operations on chord diagrams.
3. Finite generation by Mobius bands and tetrahedra.
4. Relations: The pentagon and the hexagon in "Pachner form".
5. Wiping chords off a tree, associators and the standard pentagon and hexagon.

Talk II:

1. Braids and horizontal chord associators.
2. The "naive" homological construction and its failure.
3. Some input from algebraic groups.
4. The basic principle: the transitive automorphism group actions on isomorphisms.
5. Parenthesized braids, parenthesized chord diagrams and associators as isomorphisms.
6. The semi-classical hexagon and the conclusion of the construction.

I will assume that people already know about finite type invariants and already know some basic things about them, such as the relation with chord diagrams and trivalent graphs modulo STU and IHX.

Hidekazu **Furusho**, furusho@kurims.kyoto-u.ac.jp

p-adic multiple zeta values

We introduce p-adic multiple polylogarithms and p-adic multiple zeta values. We define p-adic multiple zeta values to be special values of p-adic multiple polylogarithms. We show their many properties, which are sometimes analogous to complex case and are sometimes peculiar to p-adic case. Finally we explain that p-adic multiple zeta values are related to the p-adic rigid fundamental groupoid of the projective line minus 3 points.

William M. **Goldman**, wmg@math.umd.edu

$\mathrm{SL}(2,\mathbb{C})$-character varieties of some elementary surfaces

This talk will survey some aspects of the geometry and dynamics of $\mathrm{SL}(2,\mathbb{C})$-character varieties of surfaces of Euler characteristic -1 and -2. Special attention will be paid to the set of real points and their interpretation in terms of geometric structures. This relates to the dynamical properties of the mapping class group action and a natural symplectic geometry.

Kazuo **Habiro**, habiro@kurims.kyoto-u.ac.jp

Cyclotomic completions of polynomial rings, and the quantum invariants of integral homology spheres

The Witten-Reshetikhin-Turaev invariants of 3-manifolds are defined for each root of unity. Let R be the completion $R = \lim_n Z[q]/((q)_n)$ of the polynomial ring $Z[q]$, where $(q)_n = (1-q)(1-q^2)...(1-q^n)$ for $n \geq 0$. We will talk about some properties of the ring $Z[q]$ and the existence of an invariant $I_M(q)$ of integral homology spheres M with values in R such that for each root of unity ζ, the substitution $I_M(\zeta)$ coincides with the Witten-Reshetikhin-Turaev invariant of M at ζ.

Mikhail **Kapranov**, kapranov@math.toronto.edu

Analogies between Legendre symbols, linking numbers and resultants

The analog of the Legendre symbol over the polynomial ring $\mathbb{F}_q[t]$ (instead of integers) can be expressed via the resultant of two polynomials. On the other hand, Legendre symbols are analogous to linking numbers in topology. The talk will discuss this triple analogy. In particular, we'll discuss linking "numbers" with values in certain torsors. These torsors are analogs of 1-dimensional spaces $< L, M >$ associated by Deligne to line bundles L, M on a curve.

Atsushi **Katsuda**, katsuda@math.okayama-u.ac.jp

Closed geodesics and heat kernels on nilpotent coverings

I will discuss the following topics using transfer operators, iterated integrals, representation of nilpotent Lie group and semi-classical analysis:

1. the decay of the heat kernels on nilpotent coverings over graphs or manifolds, and

2. the growth of the number of prime closed geodesics for nilpotent extension of manifolds with negative curvature.

Akio **Kawauchi**, kawauchi@sci.osaka-cu.ac.jp

Group, lattice point, and rational number corresponding to closed orientable 3-manifold

Let $\mathbb{M}$ be the set of closed connected orientable 3-manifolds, $\mathbb{L}$ the set of unoriented links in S^3, and $\mathbb{X}$ the well-ordered set of lattice points ordered by a canonical order. In this talk, we shall explain how to construct an embedding

$$\alpha : \mathbb{M} \longrightarrow \mathbb{L}$$

so that
(1) α is a right inverse of the 0-surgery map and
(2) α induces further three embeddings

$$\pi_\alpha : \mathbb{M} \longrightarrow \mathbb{G} ,$$

$$\sigma_\alpha : \mathbb{M} \longrightarrow \Delta ,$$

and

$$\hat{\sigma}_\alpha : \mathbb{M} \longrightarrow [0, \frac{1}{2})_{\mathbb{Q}} ,$$

where $\mathbb{G}$, Δ, and $[0, \frac{1}{2})_{\mathbb{Q}}$ denote the set of link groups, a subset of $\mathbb{X}$ called the *delta set*, and the set of rational numbers in the half-open interval $[0, \frac{1}{2})$, respectively.

Combining the existence of π_α with the Kirby calculus theorem implies that the homeomorphism problem on $\mathbb{M}$ can be in principle replaced by the isomorphism problem on $\mathbb{G}$. If the lattice point $\sigma_\alpha(M)$ or the rational number $\hat{\sigma}_\alpha(M)$ is given, then we can construct the remaining $\sigma_\alpha(M)$ or $\hat{\sigma}_\alpha(M)$, the link $\alpha(M) \in \mathbb{L}$, the group $\pi_\alpha(M) = \pi_1(S^3 - \alpha(M))$, and the 3-manifold $M \in \mathbb{M}$.

The content of this talk except the argument on the embedding $\hat{\sigma}_\alpha$ which is recently established is in the following paper:

A. Kawauchi, "The classification problem of closed orientable 3-manifolds" (http://www.sci.osaka-cu.ac.jp/~kawauchi/index.htm).

Toshitake **Kohno**, kohno@ms.u-tokyo.ac.jp

Iterated integrals on configuration spaces, loop space homology, and formal flat connections

Based on Chen's iterated integrals we describe the de Rham cohomology of the loop spaces of configuration spaces. Its dual space has a structure of Poisson algebra which is a generalization of the Goldman bracket. We discuss such algebraic structure in view of string topology due to Chas and Sullivan. A formal flat connection associated with surfaces gives as its horizontal section a series of functions generalizing both hypergeometric functions and elliptic functions.

Sadayoshi **Kojima**, sadayosi@is.titech.ac.jp

The Dehn filling space of a certain hyperbolic 3-orbifold

We construct the first example of a one-cusped hyperbolic 3-orbifold (regrettably rather than a manifold) for which we see the true boundary of the space of hyperbolic Dehn fillings.

Shin-Ya **Koyama**, koyama@math.keio.ac.jp

Multiple zeta functions

(This is joint work with N. Kurokawa): Multiple zeta functions are the zeta functions having zeros or poles at sums of zeros or poles of the original zeta functions. We report on a recent development on them, and discuss possible applications.

Masato **Kurihara**, m-kuri@comp.metro-u.ac.jp

Iwasawa theory and the values of zeta functions

Iwasawa theory describes the relations between arithmetic objects and the values of zeta functions, which are usually formulated as the main conjectures. We plan to talk about several refined versions of the main conjectures and their progress. Especially, we talk about Euler systems, higher Alexander polynomials, equivariant Bloch-Kato conjecures, etc.

Masanori **Morishita**, morisita@kappa.s.kanazawa-u.ac.jp

Number theory and three-dimensional topology

I will discuss some analogies between number theory and knot theory which have their origins in the work of Gauss. The following issues will be covered: quadratic residues and linking numbers, higher residue symbols and higher linking numbers, genus theory for primes and knots, Iwasawa and and Alexander modules, and some related issues.

Kunio **Murasugi**, murasugi@math.toronto.edu

Classical knot invariants and elementary number theory

I propose one problem on Hilbert class fields motivated from an observation on the Alexander polynomial. This problem was originally conjectured by Prof. Heilbronn during our conversation in 1970's. Quite recently, Morishita showed me a counter-example. However, the conjecture holds for some knots.

Ken'ichi **Ohshika**, ohshika@math.wani.osaka-u.ac.jp

Convergence theorem for function groups

This is a joint work with Inkang Kim. One of the ultimate goals of Kleinian group theory is to determine the topological structures of the deformation spaces. The first step for this would be to give criteria for sequences of deformations to converge inside the spaces. Such a criterion is given for quasi-Fuchsian groups by Bers and Thurston. Thurston also conjectured that an analogous criterion exists for Schottky groups, and more in general, for function groups. We shall show that his conjecture is indeed true.

Makoto **Sakuma**, PXU11327@nifty.ne.jp

Markoff triples, quasifuchsian groups, and 2-bridge knot groups

A Markoff triple is a triple (x, y, z) of complex numbers satisfying the Markoff equation $x^2 + y^2 + z^2 = xyz$. Each nontrivial Markoff triple determines (up to conjugacy) a 2-generator subgroup $< A, B >$ of $SL(2, C)$ such that $tr[A, B] = -2$ and $(trA, trAB, trB) = (x, y, z)$. If (x, y, z) is the simplest Markoff triple $(3, 3, 3)$, then the subgroup is discrete and free, and is identified with the fundamental group of the hyperbolic once-punctured torus with a three-fold symmetry. If $(x, y, z) = (0, a, ia)$ with $a = exp(\pi i/6)$, then Γ is commensurable with the figure-eight knot group. Moreover, every two-bridge knot group corresponds to a Markoff triple $(0, a, ia)$ for some algebraic integer a. In this talk, I will explain the following results which are obtained through joint work with

Hirotaka Akiyoshi, Masaaki Wada, Yasushi Yamashita, and through joint work with Hirotaka Akiyoshi, Hideki Miyachi, and Caroline Series.

(1) Relation between the 2-bridge knot groups and the quasifuchsian punctured torus groups.

(2) Refinements and variations of the following McShane's identity:

$$\sum_{\gamma} \frac{1}{1 + exp(l(\gamma))} = 1/2,$$

where γ runs over the simple closed geodesics of a hyperbolic punctured torus and $l(\gamma)$ denotes the hyperbolic length.

Yuji **Shimizu**, shimizu@icu.ac.jp

Seiberg-Witten Integrable Systems and Periods of Marked Rational Elliptic Surfaces

We describe a symplectic structure on the moduli space of marked rational elliptic surfaces with solutions to a differential equation. This last equation, which we call Seiberg-Witten differential equation, is the equation for the Seiberg-Witten differential which governs the Seiberg-Witten integrable system.

We consider a rational elliptic surface together with a section and a non-singular fiber. A marking for such a triple means a usual homological marking for the mixed Hodge structure on the associated open surface as well as a specification of a holomorphic 1-form on the chosen fiber. Our integrable system is related with E-strings.

Yuichiro **Taguchi**, taguchi@math.kyushu-u.ac.jp

On the finiteness of various Galois representations

I will discuss some cases where one can prove the finiteness of the number of the isomorphism classes of certain Galois representations of number fields. A case of interest for us is the "mod p" case (motivated by Serre's conjecture) and another case is the p-adic case (which is part of the Fontaine-Mazur conjecture).

Tomohide **Terasoma**, terasoma@gauss.ms.u-tokyo.ac.jp

Bar construction for Mumford Schottky curves

We compute the limit Hodge structure of bar construction for Mumford-Schottky family. The limit is computable by the result of Kaneko-Zagier-Racinet on regularized multiple zeta values.

Hiroshi **Tsunogai**, `tsuno@mm.sophia.ac.jp`

Some new-type equations in the Grothendieck-Teichmüller group

We found some new-type equations which the elements of the absolute Galois group of $\mathbb{Q}$ satisfy in the Grothendieck-Teichmüller group by considering various embeddings of punctured projective lines into the moduli space of the projective line with five marked points. This work includes another proof of the "half-pentagon relation" of Lochak-Nakamura-Schneps.

Ismar **Volic**, `ismarv@math.brown.edu`

Finite type invariants and calculus of functors

In this talk, I will present a topological construction which provides a new point of view on finite type knot invariants. Namely, a certain tower in Goodwillie's calculus of embeddings turns out to be a classifying object for these invariants. Upon quickly reviewing the most important definitions and results from finite type theory, I will present the construction of the Goodwillie tower for the space of knots, and then describe how finite type invariants factor through it. I will also mention some possible consequences arising from the fact that this construction provides an interpretation of finite type invariants more deeply based in algebraic topology then the physics-inspired approach initiated by Kontsevich. Time permitting, I will at the end briefly discuss the Bott-Taubes integrals of configuration spaces which are central to the proof of the main theorem.

Masakazu **Yamagishi**, `yamagisi@math.kyy.nitech.ac.jp`

An analogue of the Nielsen-Schreier formula for pro-p groups

The Galois group of the maximal pro-p extension of a local field is either a free pro-p group or a Demushkin group. It is well known that free pro-p groups are characterized by the Nielsen-Schreier formula, and similar result is known for Demushkin groups. We introduce a condition analogous to the Nielsen-Schreier formula, and investigate basic properties of pro-p groups satisfying the condition.

Yoshiyuki **Yokota**, `jojo@math.metro-u.ac.jp`

How to compute the A-polynomial of hyperbolic knots

The A-polynomial of a knot, derived from the $\mathrm{SL}(2,\mathbb{C})$-representation space of the knot group, contains much information about boundary slopes and exceptional surgeries, but it remains difficult to compute. In this talk, for a hyperbolic knot K, we combinatorially construct a complex function, which is derived from the "optimistic" limit of the colored Jones polynomial of K and closely related to the geometry of the complement of K, and compute the A-polynomial K from its derivatives. In particular, we give a recursive formula of the A-polynomial of the $(-2,3,n)$-pretzel knots.