

Quantum Topology and Hyperbolic Geometry Conference

Da Nang, May 27–31, 2019

Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
8:00–8:50	Registration	Bar-Natan	Liu	Porti	Kalfagiani
9:10–10:00	Sikora	Beliakova	Tian	Purcell	Tran
10:30–11:20	Kofman	Queffelec	Chen	Jeon	Wong
11:40–12:30	Nawata	Wedrich	Karuo (30')	Irmer	Bonahon
12:30–14:00	Lunch	Lunch	Lunch	Lunch	Lunch
14:00–14:50	Kania-Bartoszynska	Discussion/free	Excursion	Discussion/free	Discussion/free
afternoon	free	free	Excursion	free	free
18:00–20:00				banquet	

Excursion: Wednesday 14:00–19:00.

Banquet: Thursday 6-8pm. Rooftop bar (22nd floor) HaiAn Beach Resort Hotel, 278 Võ Nguyên Giáp.

Abstracts

- **Bar-Natan, Dror** (University of Toronto, Canada)

Everything around $sl^{\epsilon}2+$ is D-PeGDO. So what?

I'll explain what "everything around" means: classical and quantum $m, ?, S, tr, R, C$, and θ , as well as P, Φ, J, D , and more, and all of their compositions. What D-PeGDO means: the category of Docile Perturbed Gaussian Differential Operators. And what $sl^{\epsilon}2+$ means: a solvable approximation of the semi-simple Lie algebra sl_2 . Knot theorists should rejoice because all this leads to very powerful and well-behaved poly-time-computable knot invariants. Quantum algebraists should rejoice because it's a realistic playground for testing complicated equations and theories. This is joint work with Roland van der Veen and continues work by Rozansky and Overbay.

Link to handout: <http://www.math.toronto.edu/~drorbn/Talks/DaNang-1905/>.

- **Beliakova, Anna**

On Functoriality of the Khovanov homology

We provide an elegant solution of the functoriality problem for Khovanov homology and any other link homology theory that factorizes through the Bar-Natan category. Among them are the Chen-Khovanov tangle homology, author's quantum annular homology and a categorification of the colored Jones polynomial in characteristic zero. We solve the problem not by replacing the original homology theory by a (more complicated) new one, but rather by showing explicitly how to correct signs in the original construction. The proofs are based on a simple geometric idea: replacing a foam with two intersecting surfaces and analyzing how deformations of these surfaces affect the foam.

This is joint work with Kris Putyra, Matt Hogancamp and Stephan Wehrli.

- **Bonahon, Francis** (University of Southern California, USA)

How to multiply matrices? From hyperbolic geometry to quantum topology

We of course know how to multiply matrices when their entries commute with each other. However, extending constructions from classical geometry (such as 2- and 3-dimensional hyperbolic geometry) to quantum topology (such as the Jones polynomial of a knot, or the Kauffman bracket skein algebra of a surface) requires the consistent multiplication of matrices with non-commuting entries. I will explain how to do this in the context of the quantum group $U_q(sl_2)$.

- **Chen, Qingtao**

Recent progress of various Volume Conjectures for links as well as 3-manifolds

The original Volume Conjecture of Kashaev-Murakami-Murakami predicts a precise relation between the asymptotics of the colored Jones polynomials of a knot in S^3 and the hyperbolic volume of its complement.

I will discuss two different directions that lead to generalizations of this conjecture. The first direction concerns different quantum invariants of knots, arising from the colored $SU(n)$ (with the colored Jones polynomial corresponding to the case $n = 2$). I will first display subtle relations between congruence relations, cyclotomic expansions and the original Volume Conjecture for colored Jones polynomials of knots. I will then generalize this point of view to the colored $SU(n)$ invariant of knots. Certain congruence relations for colored

$SU(n)$ invariants, discovered in joint work with K. Liu, P. Peng and S. Zhu, lead us to formulate cyclotomic expansions and a Volume Conjecture for these colored $SU(n)$ invariants. I will also discuss similar ideas for the superpolynomials that arise in HOMFLY-PT homology. In fact, I proposed cyclotomic expansion conjectures and Volume conjectures for superpolynomials.

Another direction for generalization involves the Witten-Reshetikhin-Turaev and (modified) Turaev-Viro quantum invariants of 3-manifolds. In a joint work with T. Yang, we formulated a new Volume Conjecture for the asymptotics of these 3-manifolds invariants evaluated at certain roots of unity, and numerically checked it for many examples. Interestingly, this conjecture uses roots of unity that are different from the one usually considered in literature. This may indicate that the understanding of this new phenomenon requires new physical and geometric interpretations that go beyond the usual quantum Chern-Simons theory. I will also introduce a work on Krillov-Reshetikhin quantum $6j$ -symbols done by J. Murakami & me.

- **Jeon, Bogwang** (Postech, Korea)

On the number of hyperbolic Dehn fillings of a given volume

Let M be an n -cusped hyperbolic 3-manifold. By Thurston's Dehn filling theorem, it is well-known that the number $N_M(v)$ of hyperbolic Dehn fillings of M with volume v is finite, and thus it is natural to ask whether there exists c (depending only on M) such that $N_M(v) < c$ for any v . In this talk, I will discuss possible approaches answering this question as well as other related questions.

- **Kalfagiani, Effie**

Asymptotic behavior of quantum representations

this talk I will discuss some progress on understanding the asymptotic behavior of certain representations of surface mapping class groups. I will also discuss some geometric properties of surface bundles detected by these asymptotics.

- **Kania-Bartoszyńska, Joanna** (National Science Foundation, USA)

Skein algebras and modules

We will recall some joint results with C. Frohman and T. Le that describe the structure of the Kauffman bracket skein algebra of a surface. We will also compute the skein module of a connected sum of products of circles and 2-spheres, and use it to get a new derivation of the trace in an analogy to the construction of the Yang-Mills measure.

- **Karuo, Hiroaki** (RIMS, Kyoto, Japan)

The reduced Dijkgraaf–Witten invariant of twist knots in the Bloch group of \mathbb{F}_p

For a closed 3-manifold M , a finite group G , and a representation $\pi_1(M) \rightarrow G$, (an invariant which is equivalent to) the image of the fundamental class of M by a map $H_3(M) \rightarrow H_3(G)$ induced by the representation and a 3-cocycle is called the Dijkgraaf–Witten invariant. In the case that $G = \mathrm{SL}_2\mathbb{C}$, Neumann described the Dijkgraaf–Witten invariant by using the Bloch group of \mathbb{C} in 2004.

In this talk, in the case that $G = \mathrm{SL}_2\mathbb{F}_p$ (\mathbb{F}_p denotes a finite field of prime order) I describe the Dijkgraaf–Witten invariant of the complements of twist knots by using the Bloch group of \mathbb{F}_p .

- **Kofman, Ilya** (CUNY, USA)

general. In this talk, I will describe results giving effective bounds on change in hyperbolic metric under Dehn surgery, and present some consequences. One consequence is that the verification of the cosmetic surgery conjecture for any given hyperbolic knot can be reduced to a finite computer search. Another consequence is to Margulis numbers of closed hyperbolic manifolds. This work is joint with David Futer and Saul Schleimer.

- **Queffelec, Hoel**

Khovanov homology for thickened surfaces

(joint works with David Rose and Paul Wedrich)

Khovanov homology was, when first defined, an invariant for links in the 3-space. It was extended by Asaeda, Przytycki and Sikora to links embedded in thickened surfaces, which can be thought of as a first step towards an extension to general 3-manifolds via Heegaard decomposition. Roberts' approach to the annulus version and its reinterpretation by Grigsby, Licata and Wehrli highlighted the fact that the annular homology arises as the first page a spectral sequence associated to a non-negative grading coming from the topology of the annulus, and converging towards usual Khovanov homology.

After discussing the origin of this non-negative grading, I'll explain how it extends to the case of general surfaces and allows to re-interpret the APS construction in terms of truncation functors.

- **Sikora, Adam**

Quantum Toric Degenerations of Skein Algebras

We explore the properties of skein algebras of surfaces by applying the theory of pseudo-Anosov diffeomorphisms and of measured foliations. In particular, we prove that every sufficiently generic measured foliation of a surface defines a quantum toric degeneration of the skein algebra. One of the consequences of this result is a novel proof of skein algebras being Ore domains, for both orientable and non-orientable surfaces. It also implies that measured foliations define toric degenerations of character varieties of surfaces.

- **Wong, Helen**

Roger-Yang's Arc Algebra

In the case of a closed surface, there is a rich body of work describing how the Kauffman bracket skein algebra can be regarded as a quantization of the Teichmuller space. In order to generalize to a surface with punctures, Roger and Yang defined an arc algebra $\mathcal{A}(\Sigma)$ that they proposed to be the analogous quantization of Penner's decorated Teichmuller space. We will discuss their approach, and in particular, we will explain how certain multiplicative properties of $\mathcal{A}(\Sigma)$ from joint work with Han-Bom Moon fits into the picture.

- **Yang, Tian** (Texas A&M University, USA)

Some progress on the volume conjecture for the Turaev-Viro invariants

In 2015, Qingtao Chen and I conjectured that at the root of unity $\exp(2\pi\sqrt{-1}/r)$ instead of the usually considered root $\exp(\pi\sqrt{-1}/r)$, the Turaev-Viro and the Reshetikhin-Turaev invariants of a hyperbolic 3-manifold grow exponentially with growth rates respectively the hyperbolic and the complex volume of the manifold. In this talk, I will present a recent joint work with Giulio Belletti, Renaud Detcherry and Effie Kalfagianni on an infinite family of cusped hyperbolic 3-manifolds, the fundamental shadow links complement, for which the conjecture is true.

- **Tran, Anh**

Left-orderability and L-space conjecture

Heegaard Floer homology is a package of 3-manifold invariants introduced by Ozsvath and Szabo. Manifolds with minimal Heegaard Floer homology are called L-spaces. The L-space conjecture of Boyer, Gordon and Watson states that an irreducible rational homology 3-sphere is an L-space if and only if its fundamental group is not left-orderable. In this talk, we will discuss this conjecture for 3-manifolds obtained by Dehn surgeries on twisted torus knots and pretzel knots.

- **Wedrich, Paul**

Categorical invariants of annular links

A classical result of Turaev identifies the positive HOMFLYPT skein algebra of the annulus with the algebra of symmetric functions. Queffelec and Rose categorified this using annular webs and foams. I will recall their construction and compute explicit symmetric functions and their categorical analogues for some links. This is joint work with Eugene Gorsky.