Joint Meeting in Mathematics The University of Hong Kong – Shenzhen International Center for Mathematics Spring 2025

Algebra, Number Theory, and Representation Theory

April 29 & 30, 2025

Room 210, Run Run Shaw Building, The University of Hong Kong

April 29, 2025 (Tuesday)		
09:25 - 09:30	Opening remarks	
09:30 - 10:30 Jiping Zhang	Brauer's height zero conjecture for two primes	
10:30 - 11:00	Coffee break	
11:00 - 12:00 Yingnan Wang	On the first sign change of Fourier coefficients of cusp forms	
12:00 - 13:00 Dražen Adamovićh	The center of affine vertex superalgebras at the critical level via W-algebras	
13:00 - 15:00	Lunch	
15:00 - 16:00 Xuhua He	Total positivity: combinatorics, geometry and representation theory	
16:00 - 16:30	Coffee break	
16:30 - 17:30 Iryna Kashuba	The Jucys–Murphy method and fusion procedure for the Sergeev superalgebra	
18:30 -20:30	Dinner	

April 30, 2025 (Wednesday)		
09:00 - 10:00 Antoine de Saint Germain	Frieze patterns at the crossroads of algebra, number theory and representation theory	
10:00 - 10:30	Coffee break	
10:30 - 11:30 Xingpeng Liu	Parabolic Induction and Simple Modules of Quantum Affine Algebras	
11:30 - 12:30 Zichen Yang	The bias conjecture for elliptic curves over finite fields and the Kronecker-Hurwitz class number relation	
12:30 - 14:00	Lunch	

--- End of Program ---

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Program

April 29 Tuesday

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09:30 - 10:30	Jiping Zhang , Peking U. Brauer's height zero conjecture for two primes
10:30 - 11:00	Coffee Break
11:00 - 12:00	Yingnan Wang , Shenzhen U. On the first sign change of Fourier coefficients of cusp forms
12:00 - 13:00	Dražen Adamovićh , U. of Zagreb, Croatia The center of affine vertex superalgebras at the critical level via W-algebras
13:00 - 15:00	Lunch
15:00 - 16:00	Xuhua He , HKU Total positivity: combinatorics, geometry and representation theory
16:00 - 16:30	Coffee Break
16:30 - 17:30	Iryna Kashuba , SUSTech The Jucys–Murphy method and fusion procedure for the Sergeev superalgebra
18:30 -	Dinner

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Program

April 30 Wednesday

09:00 - 10:00	Antoine de Saint Germain, HKU
	Frieze patterns at the crossroads of algebra, number theory and
	representation theory
10:00 - 10:30	Coffee Break
10:30 - 11:30	Xingpeng Liu, SUSTech
	Parabolic Induction and Simple Modules of Quantum Affine Algebras
11:30 - 12:30	Zichen Yang, U. of Science and Technology of China
	The bias conjecture for elliptic curves over finite fields and the
	Kronecker-Hurwitz class number relation
12:30 - 14:00	Lunch

— End of Program —

Dražen Adamovićh U. of Zagreb, Croatia

The center of affine vertex superalgebras at the critical level via W-algebras

The basic problem for vertex algebras at the critical level is to describe their centers. In the Lie algebra case, the center was described by B. Feigin and E. Frenkel and it is isomorphic to principal affine W-algebras at the critical level. In the Lie superalgebra case, the structure of the center at the critical level is much more complicated since the center need not be finitely generated and the principal affine W-algebras are not commutative.

In this talk we describe recent progress in describing the center for affine vertex superalgebras associated to $\mathfrak{sl}(m|n)$. We discuss a general conjecture about the structure of the center and prove it in a number of cases by identifying the associated affine W-algebras. We present details in the case of Lie superalgebra sl(2|1). In this case, we also show how the inverse quantum hamiltonian reduction can be applied on vertex algebras at the critical level.

This talk is based on joint work with B. Feigin and S. Nakatsuka.

Xuhua He HKU

Total positivity: combinatorics, geometry and representation theory

An invertible matrix is called totally positive if all its minors are positive. In 1994, Lusztig developed the theory of total positivity for arbitrary split real reductive groups and their flag manifolds. He further generalized the theory to arbitrary Kac-Moody groups in 2019. The theory of total positivity has found important applications in different areas: cluster algebras, higher Teichmuller theory, the theory of amplituhedron in physics, etc.

In this talk, we will discuss some remarkable combinatorial, geometric and representation-theoretic aspects of total positivity. This talk is based on some recent works with Huanchen Bao.

Iryna Kashuba SUSTech

The Jucys–Murphy method and fusion procedure for the Sergeev superalgebra

We use the Jucys–Murphy elements to construct a complete set of primitive idempotents for the Sergeev superalgebra. We apply them to give a version of the seminormal form for the irreducible modules with an explicit construction of basis vectors. We show that the idempotents can also be obtained from a new version of the fusion procedure.

Xingpeng Liu SUSTech

Parabolic Induction and Simple Modules of Quantum Affine Algebras

The classification and construction of irreducible weight modules over affine Kac-Moody Lie algebras have been extensively studied in the literature. An effective approach to the classification of irreducible modules is parabolic induction. More specifically, this method reduces the classification problem to the characterization of irreducible torsion-free modules, which form a distinguished class of modules that are not obtained via induction from modules over smaller subalgebras. Quantum affine algebras inherit a rich representation theory closely mirroring their classical counterparts. In this talk, I will focus on the category of weight modules with finitedimensional weight spaces over quantum affine algebras. In particular, I will present an explicit construction of a class of simple weight modules, and address the problems of category equivalence and the classification of simple modules. This talk is based on joint work with V. Futorny.

Antoine de Saint Germain HKU

Frieze patterns at the crossroads of algebra, number theory and representation theory

In this talk, I will describe how the rather elementary and combinatorial notion of frieze patterns conceals interesting mathematics in algebra, number theory and representation theory, and has led to much work on the topic in the last two decades.

Yingnan Wang Shenzhen U.

On the first sign change of Fourier coefficients of cusp forms

In the talk, we will survey some recent progress on the first sign change of Fourier coefficients of cusp forms and present a variant of the current widely used method initiated by Choie and Kohnen in the study of the location of the first sign change of the Fourier coefficients of a holomorphic cusp form when all the coefficients are real. This variant of Choie and Kohnen's method applies to more cases including integral weight cusp forms on congruence subgroups of any levels as well as half-integral weight cusp forms. This is a joint work with Guohua Chen and Yuk-Kam Lau.

Zichen Yang U. of Science and Technology of China

The bias conjecture for elliptic curves over finite fields and the Kronecker-Hurwitz class number relation

In this talk, I will discuss a version of Miller's bias conjecture for second moments in the setting of elliptic curves over finite fields whose trace of Frobenius lies in a fixed arithmetic progression. By classical results of Deuring, it is closely related to the moments of Hurwitz class numbers in the arithmetic progression. Using the theory of Rankin-Cohen brackets and holomorphic projection, we prove a recursive formula relating higher moments of Hurwitz class numbers to the zeroth moment. Then by splitting the quasi-modular Eisenstein series, we prove an explicit formula expressing the zeroth moment in terms of twisted divisor functions and Fourier coefficients of holomorphic cusp forms. This can be considered as a generalization of the Kronecker-Hurwitz class number relation. Finally, we discuss the applications of the formulas to the bias conjecture for elliptic curves over finite fields. This is a joint work with Ben Kane and Sudhir Pujahari.

Jiping Zhang Peking U.

Brauer's height zero conjecture for two primes

Brauer's Height Zero Conjecture was proposed in 1955 and has been one of the most fundamental and challenging problems in the representation theory of finite groups. The conjecture was extensively investigated and was finally confirmed in 2024. We consider its generalizations and verify a conjecture by Malle and Navarro.