

Joint Meeting in Mathematics
The University of Hong Kong – Shenzhen International Center for Mathematics
Spring 2024

Algebra and Number Theory

March 8 & 9, 2024

Room 217, Main Building, The University of Hong Kong

| March 8, 2024 (Friday) | |
|--|---|
| 09:25 - 09:30 | <i>Opening remarks</i> |
| 09:30 - 10:30 Efim Zelmanov | Title: How Algebras Grow |
| 10:30 - 11:00 | <i>Coffee break</i> |
| 11:00 - 12:00 Yuk-Kam Lau | Title: The first sign change problem of the Fourier coefficients of modular forms |
| 12:00 - 13:00 Qing Xiang | Title: Cameron-Liebler Line Classes, Tight Sets and Strongly Regular Cayley Graphs |
| 13:00 - 15:00 | <i>Lunch</i> |
| 15:00 - 16:00 Benjamin Kane | Title: Representations of integers as sums of four polygonal numbers and partial theta functions |
| 16:00 - 16:30 | <i>Coffee break</i> |
| 16:30 - 17:30 Zhicheng Feng | Title: Radical subgroups of finite reductive groups |
| 18:30 - 20:30 | <i>Dinner</i> |

| March 9, 2024 (Saturday) | |
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| 09:00 - 10:00 Chieh-Yu Chang | Title: On multiple zeta values in positive characteristic |
| 10:00 - 10:30 | <i>Coffee break</i> |
| 10:30 - 11:30 Ziqing Xiang | Title: Quantum wreath products and their representations |
| 11:30 - 12:30 Kei-Yuen Chan | Title: Dual of the Geometric Lemma for Reductive p-adic Groups |
| 12:30 - 14:00 | <i>Lunch</i> |

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March 8
Friday

Program

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| 09:25 - 09:30 | <i>Opening Remarks</i> |
| 09:30 - 10:30 | Efim Zelmanov , SUSTech <i>How Algebras Grow</i> |
| 10:30 - 11:00 | Coffee Break |
| 11:00 - 12:00 | Yuk-Kam Lau , HKU <i>The first sign change problem of the Fourier coefficients of modular forms</i> |
| 12:00 - 13:00 | Qing Xiang , SUSTech <i>Cameron-Liebler Line Classes, Tight Sets and Strongly Regular Cayley Graphs</i> |
| 13:00 - 15:00 | Lunch |
| 15:00 - 16:00 | Benjamin Kane , HKU <i>Representations of integers as sums of four polygonal numbers and partial theta functions</i> |
| 16:00 - 16:30 | Coffee Break |
| 16:30 - 17:30 | Zhicheng Feng , SUSTech <i>Radical subgroups of finite reductive groups</i> |
| 18:30 – | Dinner |

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| Program | March 9 Saturday |
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| 09:00 - 10:00 | Chieh-Yu Chang , National Tsing Hua University <i>On multiple zeta values in positive characteristic</i> |
| 10:00 - 10:30 | Coffee Break |
| 10:30 - 11:30 | Ziqing Xiang , SUSTech <i>Quantum wreath products and their representations</i> |
| 11:30 - 12:30 | Kei-Yuen Chan , HKU <i>Dual of the Geometric Lemma for Reductive p-adic Groups</i> |
| 12:30 - 14:00 | Lunch |

— End of Program —

Kei-Yuen Chan HKU

Dual of the Geometric Lemma for Reductive p -adic Groups

The geometric lemma for reductive p -adic groups describes a filtration of a parabolically induced module under Jacquet functors, as an analog of the Mackey theory of finite groups. In this talk, I will explain how to describe the dual of such filtration via the opposite Jacquet functors. An important ingredient in the proof is the intersection of Bruhat cells. I will also explain relations to Bernstein-Casselman second adjointness theorem and applications in the study of some inadmissible representations in branching laws.

Chieh-Yu Chang National Tsing Hua University

On multiple zeta values in positive characteristic

In this talk, we will introduce multiple zeta values over function fields in positive characteristic, including the so-called ∞ -adic and v -adic cases. We will report recent developments on these special values and connection between them. Primary methods from transcendence theory will be also mentioned.

Zhicheng Feng SUSTech

Radical subgroups of finite reductive groups

Radical subgroups are important in both group theory and representation theory of finite groups. In this talk, we will discuss the classification of radical subgroups of finite reductive groups.

Benjamin Kane HKU

Representations of integers as sums of four polygonal numbers and partial theta functions

In this talk, we consider representations of integers as quaternary sums of classical polygonal numbers (i.e., those with positive parameters). Using the circle method and a recent realization of partial theta functions as quantum modular forms, we show that the number of representations is equidistributed in each of the quadrants where the parameters of each of the four variables are fixed to be positive or negative. This is joint work with Kathrin Bringmann and Min-Joo Jang.

Yuk-Kam Lau HKU

The first sign change problem of the Fourier coefficients of modular forms

In this talk, we focus on the Fourier coefficients of modular forms, specifically addressing the issue of the first occurrence of sign changes when all Fourier coefficients are real. We will give an overview and discuss various research works on this problem.

Qing Xiang SUSTech

Cameron-Liebler Line Classes, Tight Sets and Strongly Regular Cayley Graphs

Cameron-Liebler line classes are sets of lines in $\text{PG}(3, q)$ having many interesting combinatorial properties. These line classes were first introduced by Cameron and Liebler in their study of collineation groups of $\text{PG}(3, q)$ having the same number of orbits on points and lines of $\text{PG}(3, q)$. During the past decade, Cameron-Liebler line classes have received considerable attention from researchers in both finite geometry and algebraic combinatorics. In the original paper [1] by Cameron and Liebler, the authors gave several equivalent conditions for a set of lines of $\text{PG}(3, q)$ to be a Cameron-Liebler line class; later Penttila gave a few more of such characterizations. We will use one of these characterizations as the definition of Cameron-Liebler line class. Let \mathcal{L} be a set of lines of $\text{PG}(3, q)$ with $|\mathcal{L}| = x(q^2 + q + 1)$, x a positive integer. We say that \mathcal{L} is a Cameron-Liebler line class with parameter x if every spread of $\text{PG}(3, q)$ contains x lines of \mathcal{L} . It turned out that Cameron-Liebler line classes are closely related to certain subsets of points (tight sets) of the Klein quadric. We will talk about a recent construction in [2] of a new infinite family of Cameron-Liebler line classes with parameter $x = (q + 1)^2/3$ for $q \equiv 2 \pmod{3}$. When q is an odd power of 2, this family of Cameron-Liebler line classes represents the first infinite family of Cameron-Liebler line classes ever constructed in $\text{PG}(3, q)$, q even. This talk is based on joint work with Tao Feng, Koji Momihara, Morgan Rodgers and Hanlin Zou.

REFERENCES

- [1] P. J. Cameron, R. A. Liebler, Tactical decompositions and orbits of projective groups, *Linear Algebra Appl.* 46 (1982), 91–102.
- [2] T. Feng, K. Momihara, M. Rodgers, Q. Xiang, H. Zou, Cameron-Liebler line classes with parameter $x = \frac{(q+1)^2}{3}$, *Advances in Math.* 385 (2021), 107780.

Ziqing Xiang SUSTech

Quantum wreath products and their representations

We introduce a new notion called the quantum wreath product, which produces an algebra $B \wr_Q H(d)$ from a given associative algebra B , a positive integer d , and a choice $Q = (R, S, \rho, \sigma)$ of parameters. Important examples include many variants of the Hecke algebras, such as the Ariki-Koike algebras, the affine Hecke algebras and their degenerate version, Wan-Wang's wreath Hecke algebras, Rosso-Savage's (affine) Frobenius Hecke algebras, Kleshchev-Muth's affine zigzag algebras, and the Hu algebra that quantizes the wreath product $\Sigma_m \wr \Sigma_2$ between symmetric groups. We will discuss the bases of quantum wreath products, and some of their representations. This is joint work with Daniel Nakano and Chun-Ju Lai.

Efim Zelmanov SUSTech

How Algebras Grow

We will discuss history and up to date results concerning growth of algebras, monoids and formal languages.