香港大學數學研究所
Institute of Mathematical Research
The University of Hong Kong

數學研究中心
Mathematics Research Center

香港中文大學(深圳)
The Chinese University of Hong Kong, Shenzhen

理工学院
School of Science and Engineering

CUHK(SZ)-HKU Representation Theory Workshop II

Date: May 13, 2025 (Tuesday)
Room: KK- LG103, KK Leung Building, HKU

09:30-09:50 **Jincheng Tang** (HKU)

09:50-10:10 **Zhenlin Ran** (HKU)

10:10-10:30 **Jiacheng Xia** (HKU)

10:30-11:05 Coffee Break

11:05-11:25 **Kaidi Wu** (HKU)

11:25-11:45 **Kenneth Chung Tak Chiu** (HKU)

11:40-12:00 **Qian Tang** (HKU)

12:00-14:30 Group Photo and Lunch

14:30-14:50 **Junwei Zha** (CUHK(SZ))

14:50-15:10 **Mohammed Saad Qadri** (HKU)

15:10-15:30 **Basudev Pattanayak** (HKU)

15:30-15:55 Coffee Break

15:55-16:15 **Xuanchen Zhao** (CUHK(SZ))

16:15-16:35 **Hongfeng Zhang** (HKU)

16:35-16:50 Break

16:50-17:10 **Yanjun Chen** (CUHK(SZ))

17:10-17:30 **Yinuo Xue** (CUHK(SZ))

18:00-20:00 Dinner

** This event is jointly organized by the Institute of Mathematical Research, HKU and the Chinese University of Hong Kong, Shenzhen; and sponsored by Glorious Sun Charity Fund.*

Titles and Abstracts

Speaker: Yanjun Chen (CUHK(SZ))

On the Classification of Schubert Varieties in Partial Flag Varieties

Schubert varieties form an extensively studied class of algebraic varieties whose properties are often characterized by combinatorics. In this talk, I will discuss the classification of Schubert varieties. I generalize the classification of isomorphism classes of Schubert varieties from complete flag varieties G/B to a class of partial flag varieties G/P. In particular, I classify all Schubert varieties in G/P where P are minimal parabolic subgroups, and all Schubert surfaces. I also obtain several classes of isomorphisms of Schubert varieties in flag varieties G/P where P are maximal parabolic subgroups. In particular, I find an upper bound of the number of isomorphism classes of Schubert threefolds.

Speaker: Kenneth Chung Tak Chiu (HKU)

Ax-Schanuel theorem for derivatives of mixed period mappings

The Ax-Schanuel theorem is a function field analogue of the Schanuel's conjecture for exponentials in transcendental number theory. This theorem is extended Hodge theoretically in the past decade. When phrased geometrically, it roughly says that if the intersection of a given algebraic variety and the graph of a period mapping is "unlikely", then this intersection should be related to group orbits of Hodge structures. We will first review the history of the subject, and recap the notions in mixed Hodge theory, including variations of mixed Hodge structures and their period mappings. A version of Ax-Schanuel for principal bundles with flat connections is proved by Blázquez-Sanz, Casale, Freitag and Nagloo. We will explain how their theorem and jet spaces can be used to deduce the Ax-Schanuel theorem for derivatives of mixed period mappings.

Speaker: Basudev Pattanayak (HKU)

Algorithms for Computing the Jacquet Modules for the General Linear Group

We will discuss an algorithm for computing certain Jacquet modules in the form of 'derivatives' of an irreducible smooth representation of GL(n, F). This talk is based on a recent work with Kei Yuen Chan.

Speaker: Mohammed Saad Qadri (HKU)

Non-tempered Ext branching laws for the General Linear Group

We study Ext branching laws for Arthur type representations of the p-adic general linear group. We give a condition predicting Ext non-vanishing in some cases.

Speaker: Zhenlin Ran (HKU)

Heights in Diophantine geometry over function fields

In this talk I will present some results regarding heights and their consequences. These results are built in the setting of function fields, especially in Drinfeld modules. This talk

will be details-free. If time permit, I shall depict some potential research topics I am working on/towards.

Speaker: Jincheng Tang (HKU)

Sum-product Phenomenon in Rings and Families of Expanders

Expanders are some sparse but strongly connected graphs which are widely studied and used in computer science and pure mathematics. Many concrete examples of expanders come from families of Cayley graphs. Let $S \subset SL2(Z) \times SL2(Z)$ be finite symmetric and assume S generates a group G which is Zariski-dense in SL2 x SL2. We prove that the Cayley graphs

$$\{Cay(G(\mathrm{mod}\ q), S(\mathrm{mod}\ q))\}_{q\in Z+}$$

form a family of expanders. This result, known as the super approximation for $SL2(Z/qZ) \times SL2(Z/qZ)$, relies crucially on a sum-product result in quotients of rings of algebraic integers, which roughly says that given a subset A of a ring R, at least one of the sum set A+A and the product set A.A will expand under some natural conditions, i.e. $\max\{|A+A|, |A.A|\} > |A|^{1+\theta}$.

Speaker: Qian Tang (HKU)

Stokes Matrices and Quantum Groups

In this short talk, I will briefly introduce the definition of Stokes matrices and their connection with Drinfel'd-Jimbo quantum groups

Speaker: Kaidi Wu (HKU)

Partial cocenter of Hecke algebra

The cocenter of Hecke algebra is important in the study of representation theory of p-adic group and affine Deligne-Lusztig variety. In this talk, we generalize to partial cocenter and give a basis of partial cocenter. This is based on a joint work in progress with Xuhua He and Felix Schremmer.

Speaker: Jiacheng Xia (HKU)

Fourier coefficients of general cusp forms and isogenies of CM elliptic curves.

Given two elliptic curves over a number field, Francois Charles proved that there are infinitely many places where the reductions of these two curves are geometrically isogenous. We address a refined version of this problem for a given pair of CM elliptic curves: for a fixed positive integer *m*, how many places are there where the reductions of the CM elliptic curves are *m*-isogenous? We establish an explicit polynomial lower bound for this question by purely automorphic methods. Gross-Zagier type theorems and higher Green functions connect our counting problem to Fourier coefficients of incoherent Eisenstein series, which then can be approximated by those of coherent Eisenstein series of increasing level. Finally we reduce the problem to obtaining a novel explicit Deligne bound for general cusp forms (not necessarily eigenforms) of arbitrary weight and level in terms of the first few Fourier coefficients, which might be a result of independent interest. This is a joint work with Edgar Assing, Yingkun Li, and Tian Wang.

Speaker: Yinuo Xue (CUHK (SZ))

Skew Duality and Fermionic Fourier Transform

In this talk, I will introduce the first fundamemtal theorem in terms of complete contraction and its application, that is, to find the commutant of the action of sympectic group on exterior algebra. This furnishes the fundamental representation of symplectic group. And I will introduce the fermionic Fourier Transform on superspace which has a natural symplectic structure related to the fundamental representation mentioned above.

Speaker: Junwei Zha (CUHK(SZ))

A Remark on Bernstein-Zelevinsky Classification for General Linear Groups

In the talk, we reveal a submodule relation among standard modules of p-adic general linear groups. This observation disproves a conjecture of Lapid-Minguez, i.e., the unique maximal submodule of a standard module is the sum of smaller submodules in the sense of Zelevinsky partial order.

Speaker: Hongfeng Zhang (HKU)

Duality between representations of complex orthogonal groups and cyclotomic Brauer algebras

Classical Schur-Weyl duality establishes a correspondence between finite-dimensional representations of GL(n) and finite-dimensional representations of symmetric group S_m. From such correspondence, the representation theories can benefit from each other. It was generalized by Arakawa-Suzuki that there is a duality between SL(n) modules in Category O to representations of the graded affine Hecke algebra.

For other classical types, there is a duality between finite-dimensional representations of SO(n) (or Sp(n)) with finite-dimensional modules of Brauer algebras. In this talk, I will talk about a duality between Harish-Chandra modules of SO(n, C) and finite-dimensional modules of cyclotomic Brauer algebras. This work is inspired by the previous works of Ciubotaru-Trapa, Chan-Wong, etc.

Speaker: Xuanchen Zhao (CUHK(SZ))

Dirac cohomology of minimal representations

Dirac cohomology is an important notion in representation theory of reductive Lie groups. The Dirac cohomology for an irreducible (g, K)-module X can be determined explicitly via direct computation involving the K-types of X and the g-infinitesimal character of X. We carried out this process for some minimal (g, K)-modules, whose K-types are very easy to describe. According to these explicit results, we put forward some conjectures on Dirac cohomology, in particular, on the cancellation of the Dirac index.