第五届代数与表示论前沿进展研讨会

会 议 手 册

2023 年 4 月 20 日-4 月 23 日

目　录

会议报到时间：

4 月 20 日　全天

会议报到地点：

北京紫玉御骊酒店

会议结束时间：

4 月 23 日　下午

会议举办单位：

首都师范大学　数学科学学院

会议组织者：

惠昌常（首都师范大学）

陈红星（首都师范大学）

刘玉明（北京师范大学）

胡　维（北京师范大学）

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日 程 安 排

4 月 21 日	地 点	新教二楼 120 教室	
8:50-9:00		特邀嘉宾张继平院士讲话	
时 间	报告人	报告题目	主持人
9:00-9:50	秦厚荣	Hardy-Littlewood 猜想与 Lang-Trotter 猜想	惠昌常
10:00-10:50	王 清	Parafermion vertex operator algebras	
11:00-11:50	何济位	An introduction to noncommutative graded isolated singularities	
			主持人
14:00-14:50	苏育才	再叙雅可比猜想	刘玉明
15:00-15:50	张 俊	Decoding of algebraic codes and related problems	
16:10-17:00	何卓衡	Some systems of quaternion matrix equations with applications	
4 月 22 日	地 点	学生活动中心青蓝厅	
时 间	报告人	报告题目	主持人
9:00-9:50	单 芃	Modularity for W-algebras and affine Springer fibers	胡维
10:00-10:50	李利平	Abelian model structures on functor categories	
11:00-11:50	黄 敏	On the ordering of the Markov numbers and the uniqueness conjecture	
			主持人
14:00-14:50	陈小伍	The dg approaches to singularity categories	陈红星
15:00-15:50	冯致程	Jordan decomposition and Alperin weight conjecture	
16:10-17:00	张金币	Centralizer matrix algebras	
4 月 23 日	地 点	新教二楼 827 教室	
时 间	报告人	报告题目	主持人
9:00-9:50	周远扬	From Alperin's weight conjecture to Rouquier's conjecture	惠昌常
10:00-10:50	胡 维	Homological conjectures under stable functors	
11:00-11:50	方 明	Some development on dominant dimension and Schur-Weyl duality	

报 告 简 介

Hardy-Littlewood 猜想与 Lang-Trotter 猜想

秦厚荣（南京大学）

假设 E 是定义在有理数数域 $\mathbb{Q}$ 上的椭圆曲线。对于素数 p，我们用 a_p 表示 Frobenius 自同态的迹。任意给定整数 r，定义 $\pi_{E,r}(x) := \sum_{p \leq x, p \nmid \Delta_E, a_p = r} 1$。Lang-Trotter 猜想断言，当 $x \to \infty$ 时

$$\pi_{E,r}(x) = C_{E,r} \cdot \frac{\sqrt{x}}{\log x} + o\left(\frac{\sqrt{x}}{\log x}\right)$$

这里 $C_{E,r}$ 是一个非负常数。我们将讨论 CM 情形两种计算常数 $C_{E,r}$ 的具体值的方法：一种是假设 Hardy-Littlewood 猜想（这个猜想给出了二次多项式表素数的渐近表达式）成立，另外一种是利用伽罗华表示理论。报告将说明，两种方法计算的结果是一致的。

Parafermion vertex operator algebras

王清（厦门大学）

Coset construction and orbifold construction are two important ways to construct new vertex operator (super)algebras from given ones. Parafermion vertex operator algebra is a special kind of coset construction related to the affine vertex operator (super)algebra. In this talk, I will present some recent progresses on affine vertex operator superalgebras and parafermion vertex operator algebras. In particular, the automorphism groups of parafermion vertex operator algebras are determined and the orbifolds of affine vertex operator superalgebras are studied.

An introduction to noncommutative graded isolated singularities

何济位（杭州师范大学）

Let A be a Noetherian graded algebra. Let $gr(A)$ be the category of finitely generated right graded A-modules, and let $tors(A)$ be the subcategory of $gr(A)$

consisting of finite dimensional modules. If the quotient category $qgr(A):=gr(A)/tors(A)$ has finite global dimension, then A is called a noncommutative graded isolated singularity. In this talk, I will report some progress on noncommutative graded isolated singularities, such as Cohen-Macaulay representations, noncommutative resolutions, Knorrer periodicity property of noncommutative quadrics.

再叙雅可比猜想

苏育才（同济大学/集美大学）

报告人将根据自己从事雅可比猜想研究 18 年的经历，总结出来的用代数、几何和分析等基础数学方法的有效结合，给出二维雅可比猜想的证明。这一方法被雅可比问题专家 Zbigniew Hajto 称为"can be useful in affine algebraic geometry"。在这个报告中，报告人将侧重讲述如何有效利用代数和分析给出多项式映射在无穷远点处的一个重要性质，该性质在二维雅可比猜想的证明中起着至关重要的作用。

Decoding of algebraic codes and related problems

张俊（首都师范大学）

In this talk, we will give a brief introduction to the fundamental problem of coding theory, the decoding problem, deep hole problem and some applications.

Some systems of quaternion matrix equations with applications

何卓衡（上海大学）

In this talk, we will consider some matrix equations over the real quaternion algebra. We give some necessary and sufficient solvability conditions for some systems of Sylvester-type quaternion matrix equations in terms of ranks, generalized inverses of matrices and block matrices. We also derive the general solutions to these systems when they are solvable. Moreover, we give some algorithms and numerical examples. We conclude with applications in image processing.

Modularity for W-algebras and affine Springer fibers

单芃（清华大学）

We will explain a bijection between admissible representations of affine Kac-Moody algebras and fixed points in affine Springer fibers. We will also explain how to match the modular group action on the characters with the one defined by Cherednik in terms of double affine Hecke algebras, and extensions of these relations to representations of W-algebras. This is based on joint work with Dan Xie and Wenbin Yan.

Abelian model structures on functor categories

李利平（湖南师范大学）

A central idea of sheaf theory is to amalgamate a family of locally compatible data indexed by objects of an index category to obtain a global datum. In this talk we apply this idea to describe a method to construct various abelian model structures on the representation categories of diagrams of abelian model categories indexed by small categories satisfying certain combinatorial properties. As byproducts, we obtain characterizations of special homological objects in representation categories. This work is joint with Di, Liang, and Yu.

On the ordering of the Markov numbers and the uniqueness conjecture

黄敏（中山大学）

A Markov triple is a solution of the Markov equation $x^2 + y^2 + z^2 = 3xyz$, a Markov number is an element in a Markov triple. It was conjectured by Frobenius in 1913 that different Markov triples have different maximal Markov numbers. In order to investigate this conjecture, we use cluster theory to study the ordering of the Markov numbers. The quantum version will be also considered.

The dg approaches to singularity categories

陈小伍（中国科学技术大学）

The singularity categories naturally lift to the dg singularity categories. The latter contain more information, and are very hard to understand. We will explain two more accessible dg enhancements for singularity categories, namely the Vogel dg categories and singular Yoneda dg categories.

Jordan decomposition and Alperin weight conjecture

冯致程（南方科技大学）

The Alperin weight conjecture was announced by J. Alperin in 1986 and constitutes one of the main problems in the modular representation theory. About ten years ago, it was reduced to the verification of certain statements for simple groups by the work of Navarro, Tiep and Spaeth. In this talk we will discuss current approaches and recent progress in the inductive investigation of the Alperin weight conjecture.

Centralizer matrix algebras

张金币（北京大学）

In this talk, we discuss the structure of centralizer matrix algebras over a field. We prove that the full matrix algebras are always Frobenius extensions of principal centralizer matrix algebras, and the latter are always Frobenius-finite, 1-Auslander-Gorenstein and gendo-symmetric. As an application, we show that the Auslander-Reiten conjecture on stable equivalences holds true for principal centralizer matrix algebras over an algebraically closed field. This is based on a joint work with Professor Changchang Xi.

From Alperin's weight conjecture to Rouquier's conjecture

周远扬（华中师范大学）

Alperin's weight conjecture is one of the most important conjectures in representation theory of finite groups. It says that the number of the isomorphism

classes of simple modules of a block algebra of a finite group over an algebraically closed field of characteristic $p > 0$ can be locally computed. Rouquier's conjecture is an algebraic interpretation of a special case of Alperin's weight conjecture and it generalizes the distinguished Broué's abelian defect group conjecture. In this talk, we give an overview of the study of Rouquier's conjecture.

Homological conjectures under stable functors

胡维（北京师范大学）

The stable functor of a derived equivalence was introduced by Hu and Xi in 2010. Later, Hu and Pan gave a general definition of stable functors of non-negative functors between derived categories which may not be derived equivalences, and proved that the stable functor of a derived equivalence always induce a triangle equivalences between the stable categories of Gorenstein projective modules. In this talk, we shall discuss the behavior of several homological conjectures under derived equivalences or singular equivalences induced by stable functors.
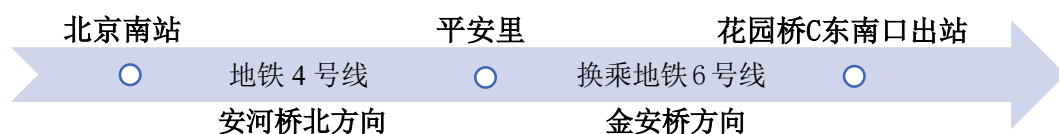
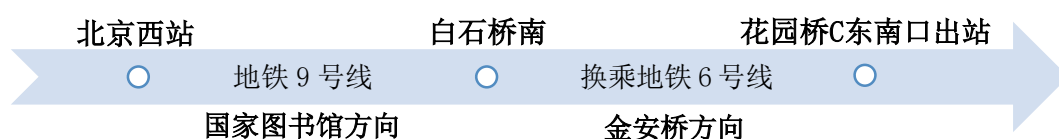## Some development on dominant dimension and Schur-Weyl duality

方明（中国科学院）

The celebrated Schur-Weyl duality has established a paradigm in representation theory that relates an algebra A to its centraliser subalgebra eAe via Schur functors. The cases where the algebras A has dominant dimension at least two, say for Schur algebras $S(n, r)$ with $n \geq r$, have been well studied. On the other hand, there are also many cases where A have dominant dimension zero, say for most Schur algebras $S(n, r)$ with $n < r$. In this talk, I make a survey on approaches to these algebras via relaltive dominant dimension by Jun Hu, Zhankui Xiao, Tiago and Erdmann and via double dual functor by Jun Hu and myself.
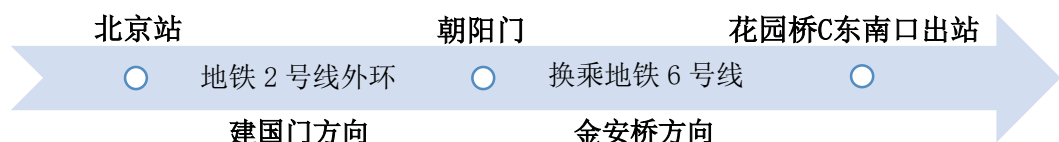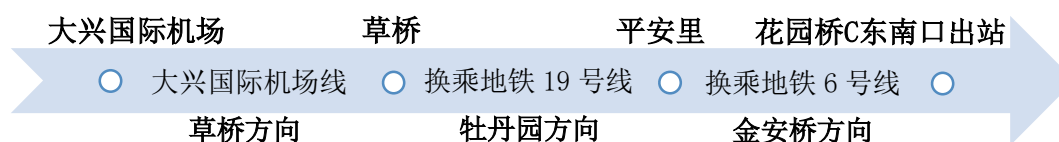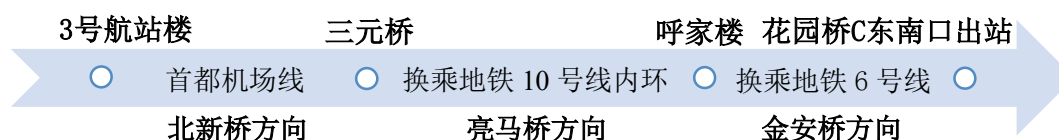
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