四川大学李理论研讨会

（2022）

会议报告人：邓少强 教授 (南开大学)
胡　峻 教授 (北京理工大学)
胡乃红 教授 (华东师范大学)
姜翠波 教授 (上海交通大学)
景乃桓 教授 (North Carolina State University)
李　方 教授 (浙江大学)
李海生 教授 (Rutgers University-Camden)
林宗柱 教授 (Kansas State University)
单　芃 教授 (清华大学)
舒　斌 教授 (华东师范大学)
苏育才 教授 (同济大学、集美大学)
孙斌勇 教授 (浙江大学)
谭绍滨 教授 (厦门大学)
王伟强 教授 (University of Virginia)
徐晓平 教授 (中国科学院数学研究所)
张贺春 教授 (清华大学)
赵开明 教授 (Wilfrid Laurier University)

会议时间：2022年10月29日, 10月30日, 11月5日 (8:30-17:30)

会议地点：线上：腾讯会议ID：635-8562-1060
链接：https://meeting.tencent.com/dm/IlWrG154HsUU
线下：成都市武侯区新南路103号祥宇宾馆2楼祥泰厅 (10月29日, 10月30日)
西南数学中心516 (11月5日)

会议主办方：四川大学数学学院

会议组织者：彭联刚, 董崇英, 任丽, 林秉辰, 谭友军, 付昌建, 耿圣飞, 杨亮, 卢明

一、会议日程

日期	时间	报告人	题目	主持人
10月29日	8:20-8:30		开幕式	董崇英
	8:30-9:20	孙斌勇 (浙江大学)	Special unipotent representations of classical Lie groups	
	9:30-10:20	王伟强 (University of Virginia)	Drinfeld presentations of affine i-quantum groups	
	10:40-11:30	胡峻 (北京理工大学)	On the center conjecture for the cyclotomic Hecke algebras and cyclotomic KLR algebras	
	11:40	休息		
	14:30-15:20	张贺春 (清华大学)	Representations of Quantum Coordinate Algebras at Generic q	白承铭
	15:30-16:20	单芃 (清华大学)	Modularity for W-algebras and affine Springer fibers	
	16:40-17:30	苏育才 (同济大学、集美大学)	多项式映射和二维雅可比猜想	

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日期	时间	报告人	题目	主持人
10月30日	8:30-9:20	景乃桓 (North Carolina State University)	Sklyanin determinants and minor identities	林秉辰
	9:30-10:20	林宗柱 (Kansas State University)	Dg-Poisson representatives and dg vertex algebras	
	10:40-11:30	谭绍滨 (厦门大学)	Elliptic Lie algebras and vertex algebras	
	11:40	休息		
	14:30-15:20	舒斌 (华东师范大学)	Jantzen filtration of Weyl modules for general linear supergroups	卢明
	15:30-16:20	邓少强 (南开大学)	Curvatures of homogeneous Finsler spaces	
	16:40	自由讨论		

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日期	时间	报告人	题目	主持人
11月5日	8:30-9:20	赵开明 (Wilfrid Laurier University)	Representations of the Fermion-Virasoro algebras	芮和兵
	9:30-10:20	李海生 (Rutgers University-Camden)	Cocommutative vertex bialgebras	
	10:40-11:30	徐晓平 (中国科学院数学研究所)	特殊线性李代数的全局射影微分算子表示	
	11:40	休息		
	14:30-15:20	李方 (浙江大学)	An elementary analysis for Galois-like theory of cluster algebras and some examples from surfaces	任丽
	15:30-16:20	姜翠波 (上海交通大学)	Classification of OZ-type VOAS generated by Ising vectors of σ-type.	
	16:40-17:30	胡乃红 (华东师范大学)	Admissible Quantum Affine Algebra of Type $A_1^{(1)}$ and its Vertex Operator Representation	

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二、报告摘要

10月29日:

Special unipotent representations of classical Lie groups

孙斌勇　(浙江大学)

One fundamental problem in representation theory is the unitary dual problem, namely to construct and classify all irreducible unitary representations of a given Lie group G. An important principle is the orbit method introduced by A. A. Kirillov, and it seeks to describe irreducible unitary representations of G by its coadjoint orbits. The most mysterious ingredient of orbit method is to attach irreducible unitary representations to nilpotent coadjoint orbits. For classical Lie groups, we construct some irreducible unitary representations attached to nilpotent coadjoint orbits, by using the theory of local theta correspondence initiated by R. Howe. These are the special unipotent representations in the sense of Arthur and Barbasch-Vogan. This is a report on a recent joint work with Dan M. Barbasch, Jia-Jun Ma and Chen-Bo Zhu.

Drinfeld presentations of affine i-quantum groups

王伟强　(University of Virginia)

Quantum symmetric pair of affine type (U, U^i) consists of a Drinfeld-Jimbo affine quantum group (a quantum deformation of a loop algebra) U and a coideal subalgebra U^i (called i-quantum group). Drinfeld obtained a (loop) presentation for U. In this talk, we give a Drinfeld type presentation for the affine quasi-split i-quantum group U^i. Along the way, we shall construct various root vectors in U^i and describe their classical limits. This is based on joint work with Ming Lu (Sichuan) and Weinan Zhang (Virginia).

On the center conjecture for the cyclotomic Hecke algebras and cyclotomic KLR algebras

胡峻　(北京理工大学)

The center conjecture for the cyclotomic Hecke algebra of type G(r,1,n) asserts that its center consists of symmetric polynomials in its Jucys-Murphy operators and its dimension is independent of the characteristics of the ground field and defining parameters. There are similar conjectures for the cyclotomic KLR algebras. In this talk we shall report our recent progress on these conjectures. This talk is based on some joint work with Shi Lei and Lin Huang.

Representations of Quantum Coordinate Algebras at Generic q

张贺春　(清华大学)

We construct a class of irreducible modules of quantum coordinate algebras, generalizing a result of Levindorski and Soibelman for highest weight modules.

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 D. Xie and W. Yan.

多项式映射和二维雅可比猜想

苏育才　(同济大学、集美大学)

雅可比猜想是个具有80多年历史的著名问题。本报告从二维多项式映射谈起，先叙述映射的三个性质，然后给出二维雅可比猜想的证明。本报告与2022年10月14日在【中俄数学中心-吉大论坛】的报告有一小部分重复，但本报告将侧重介绍映射的最重要的性质。

10月30日:

Sklyanin determinants and minor identities

景乃桓　(North Carolina State University)

This talk is on invariant theory of quantum symmetric spaces of symplectic and orthogonal types. We explicitly realize the quantum symmetric spaces as subrings of the quantum coordinate ring $M_q(N)$ and study the relations among the quantum determinant, the Sklyanin determinant of orthogonal and symplectic types, and their associated quantum Pfaffians. We will generalize several classical identities such as Jacobi identities, Cayley's complementary identities, Sylvester identities, and the minor identities in both orthogonal and symplectic types as well as their q-Pfaffian analogues. This is joint work with Jian Zhang.

Dg-Poisson representatives and dg vertex algebras

林宗柱　(Kansas State University)

Associated to a vertex operator algebras V, there are two associative algebras: the Zhu-algebra $A(V)$ and the C_2-algebra $R(V)$. The C_2-algebra $R(V)$ is a commutative algebra with a Poisson structure and the Zhu algebra $A(V)$ has a natural filtered structure which is almost commutative. The representation theory of V is closely related to the filtered representations of $A(V)$ and the Poisson representations of $R(V)$. In this talk, we define vertex operator algebras in the category of differential graded vector spaces and explore the analogous functorial relations among the various representations. In this case the Zhu algebra is no longer a filtered dg-algebra and new structures naturally arise. Given any dg vertex operator algebra, its cohomology vertex algebra is a graded vertex algebra, which automatically defines a super vertex operator algebra. This is a joint work with Antoine Caradot and Cuipo Jiang.

Elliptic Lie algebras and vertex algebras

谭绍滨　(厦门大学)

Elliptic Lie algebras are nullity two extended affine Lie algebras. In this talk we first review some some basic results for affine vertex algebras and extended affine Lie algebras, and also recall the notion of equivariant ϕ coordinated quasi-modules for vertex algebras arising from certain infinite dimensional Lie algebras. We state that there exist a vertex algebra V and an automorphism group G of V equipped with a linear character χ, such that the category of restricted modules for elliptic Lie algebra E of maximal type is isomorphic to the category of (G, χ)-equivariant ϕ-coordinated quasi modules for the vertex algebra V. We also prove that the integrable restricted E-modules with nonnegative integer level are exactly the (G, χ)-equivariant \phi-coordinated quasi modules for a quotient vertex algebra of V.

Jantzen filtration of Weyl modules for general linear supergroups

舒斌　(华东师范大学)

Let $G = GL(m|n)$ be a general linear supergroup over an algebraically closed field k of odd characteristic p. In this talk we construct Jantzen filtration of Weyl modules $V(\lambda)$ for G when λ is a typical weight in the sense of Kac's definition, and consequently obtain a sum formula for their characters. By Steinberg's tensor product theorem, it is enough for us to study typical weights with aim to formulate irreducible characters. As an application, it turns out that an irreducible G-module $L(\lambda)$ can be realized as a Kac module if and only if λ is p-typical. This is a joint work with Yiyang Li.

Curvatures of homogeneous Finsler spaces

邓少强　(南开大学)

Cuvatures are the most important quantities in differential geometry. In Finsler geometry, there are several types of curvatures, including flag curvature, Ricci curvture, S-curvature, etc. In this

talk, we give a survey of the results concerning curvatures of homogeneous Finsler spaces obtained in recent years. The main topics include curvatures of symmetric Finsler spaces, weakly symmetric spaces and homogeneous Randers spaces. This talk is based on joint work of Deng, Hu and Xu.

11月5日:

Representations of the Fermion-Virasoro algebras

赵开明 (Wilfrid Laurier University)

We introduce Fermion algebras F and the Fermion-Virasoro algebras S. They are infinite-dimensional Lie superalgebras. The progress on simple smooth modules and simple Harish-Chandra modules over these algebras will be discussed.

Cocommutative vertex bialgebras

李海生 (Rutgers University-Camden)

In this talk, we shall discuss the structure of cocommutative vertex bialgebras. For a general vertex bialgebra V, we show that the set $G(V)$ of group-like elements is naturally an abelian semigroup, whereas the set $P(V)$ of primitive elements is a vertex Lie algebra. For $g \in G(V)$, denote by V_g the connected component containing g. Among the main results, we show that if V is a cocommutative vertex bialgebra, then $V = \oplus_{g\in G(V)} V_g$, where $V_{\mathbf{1}}$ is a vertex subbialgebra which is isomorphic to the vertex bialgebra $\nu_{P(V)}$ associated to the vertex Lie algebra $P(V)$, and V_g is a $V_{\mathbf{1}}$ -module for $g \in G(V)$. In particular, this shows that every cocommutative connected vertex bialgebra V is isomorphic to $\nu_{P(V)}$ and hence establishes the equivalence between the category of cocommutative connected vertex bialgebras and the category of vertex Lie algebras. Furthermore, under the condition that $G(V)$ is a group and lies in the center of V, we prove that $V = \nu_{P(V)} \otimes \mathbb{C}[G(V)]$ as a coalgebra where the vertex algebra structure is explicitly determined. This talk is based on a joint work with Jianzhi Han and Yukun Xiao.

特殊线性李代数的全局射影微分算子表示

徐晓平 (中国科学院数学研究所)

n-维空间上的射影变换导出了特殊线性李代数的一个非齐次一阶微分算子表示。多年前赵玉凤和我利用该表示和沈光宇关于Witt代数表示的混合张量积构造了一个从gl(n)-Mod 到sl(n+1)-Mod的函子，并给出该函子将有限维不可约gl(n)-模映成无限维不可约sl(n+1)-模的一个充分条件。最近，周振宇和和我从sl(2)开始，逐次应用该函子给出了sl(n+1)的所有有限维不可约表示的一阶微分算子的实现，并与典型组合等式有关。

An elementary analysis for Galois-like theory of cluster algebras and some examples from surfaces

李方　(浙江大学)

One of the key-points in Galois theory via field extensions is to build up a correspondence between subfields of a field and subgroups of its automorphism group, so as to study fields via methods of groups. As an analogue of the Galois theory, we study the relations between cluster subalgebras of a cluster algebra and subgroups of its automorphism group and then to set up the Galois-like method.As examples, we characterize the cluster automorphism group of cluster algebras from feasible surfaces of genus g = 0. For the kind of cluster algebras, as the answers of two conjectures given in the first part, we prove the rank invariants of maximal cluster subalgebras under action of subgroups of the cluster automorphism group of such a cluster algebra and moreover construct the descending series of cluster subalgebras via an ascending series of subgroups.This work is joint with Jinlei Dong.

Classification of OZ-type VOAS generated by Ising vectors of σ-type

姜翠波　(上海交通大学)

We give a full classification and characterization of OZ-type vertex operator algebras generated by Ising vectors of σ-type, and obtain Matsuo's classification of the center-free 3-transposition groups of symplectic type realizable by a OZ-type VOA generated by Ising vectors of σ-type without the assumption that the VOA carries a positive-definite Hermitian form.

Admissible Quantum Affine Algebra of Type $A_1^{(1)}$ and its Vertex Operator Representation

胡乃红　(华东师范大学)

In this talk, we will present a new quantum affine algebra of type $A_1^{(1)}$, which we call admissible. Then we construct its quantum vertex operator representation of level one. This is based on joint work with Ge Feng, Rushu Zhuang and Xin Zhong, respectively.