Two-Sided Linear Quaternionic Equations: History, Structure, and the Discriminant Space Method

Kaiming Zhao
Wilfrid Laurier University, Canada

Abstract: In this talk, a method to solve two-sided linear quaternionic equations will be given by introducing a new concept: discriminant space. We provide the sufficient and necessary criteria for the existence of the solutions and a method to obtain all solutions efficiently. Furthermore, the similar theories are established for systems of general two-sided linear quaternionic equations, and two-sided linear quaternionic equations with conjugate. This is based on a joint paper with Yulu Chen, Bowen Liu and Bin Wang.

Time: 7.17 (Friday), 8:30 – 9:30
Venue: Mingde Building B201-1

Geometric approach to mirabolic Schur duality and Howe duality

Zhaobin Fan
Harbin Engineering University

Abstract: In this talk, I will introduce the geometric approach to the Schur duality and Howe duality in the mirabolic setting. This is a joint work with H. Ma and Z. Zhang.

Time: 7.17 (Friday), 9:50 – 10:50
Venue: Mingde Building B201-1

Vertex algebras, Conformal Lie algebras, and cocommutative vertex bialgebras

Haisheng Li, Rutgers University–Camden, USA

Abstract: This talk is on the interactions among vertex algebras, vertex Lie algebras, and vertex bialgebras. From definition, every vertex algebra is naturally a conformal Lie algebra, namely a vertex Lie algebra. On the other hand, it is known that associated to every conformal Lie algebra C one has an authentic Lie algebra C_{Lie}, and furthermore has a canonical vertex algebra V_C with $U(C_{\mathrm{Lie}})$ as its underlying space. We show that V_C is a connected cocommutative vertex bialgebra. On the other hand, for a general vertex bialgebra V, we show that the set $P(V)$ of primitive elements is a vertex Lie algebra. Furthermore, we show that if V is a connected cocommutative vertex bialgebra, then V is isomorphic to the vertex bialgebra $V_{P(V)}$ associated to the vertex Lie algebra $P(V)$. In particular, this shows that every cocommutative connected vertex bialgebra V is isomorphic to $V_{P(V)}$ and hence establishes the equivalence between the category of cocommutative connected vertex bialgebras and the category of vertex Lie algebras. This talk is partially based on a joint work with Jianzhi Han and Yukun Xiao.

Time: 7.17 (Friday), 10:50 – 11:50
Venue: Mingde Building B201-1

Induced structures of operated algebras

Li Guo, Rutgers University–Newark, USA

Abstract: In recent years, a lot of attention has been attracted to operated algebras, defined to be algebras equipped with various linear operators, such as derivations and Rota–Baxter operators. An important aspect in their study is that they induce new algebraic structures defined by binary quadratic relations. For example, a differential commutative algebra induces a Novikov algebra and a Rota–Baxter Lie algebra induces a pre-Lie algebra or a post-Lie algebra. While these new structures are important, the meaning of "being induced" has been informal. This talk presents a general framework to define and understand such induced structures. The talk is based on joint works with Shiyuan Huang, Shanghua Zheng, Xiaoyan Wang and Huhu Zhang.

Time: 7.17 (Friday), 14:00 – 15:00
Venue: Mingde Building B201-1

Conjectures on Local Derivations, Local Automorphisms, and Almost Inner Derivations

Liangyun Chen
Northeast Normal University

Abstract: In this talk, we utilize the notion of the reflexive hull to unify the concepts of local derivations, almost inner derivations, and local automorphisms. By investigating the algebraic structure of reflexive hulls, we prove the conjectures on the structures of local derivations and local automorphisms proposed by S. Ayupov, A. Elduque, and K. Kudaybergenov (J. Pure Appl. Algebra, 2023), as well as the conjecture concerning the structure of almost inner derivations proposed by D. Burde, K. Dekimpe, and B. Verbeke (J. Algebra Appl., 2018). Specifically, we prove that for any finite-dimensional algebra, the space of local derivations forms a Lie algebra, and the set of local automorphisms forms a Lie group whose Lie algebra is precisely the space of local derivations. Furthermore, we show that the space of almost inner derivations forms an ideal of the derivation algebra.

Time: 7.17 (Friday), 15:20 – 16:20
Venue: Mingde Building B201-1

Nilpotent orbits under enhanced group action and their closures

Bin Shu

East China Normal University

Abstract: Associated with $G := \mathrm{GL}_n$ and its rational representation (ρ, M) over an algebraically closed field k, we define an enhanced reductive algebraic group $\mathbf{G} := G \ltimes_\rho M$ which is a product variety $\mathrm{GL}_n \times M$, endowed with an enhanced cross product. Related to enhanced reductive groups, there have been series of research work recently achieved. In this talk, we focus our concern on nilpotent orbits under the enhanced group action. We first show that the nilpotent cone $\tilde{\mathcal{N}} := \mathcal{N}(\tilde{\mathfrak{g}})$ *of* the enhanced Lie algebra $\tilde{\mathfrak{g}} := Lie(\mathbf{G})$ *has finite nilpotent orbits under adjoint* $\mathbf{G}$*-action if and only if,* up to tensors with one-dimensional modules, M is isomorphic to one of the three kinds of modules: (i) a one-dimensional module, (ii) the natural module k^n, (iii) the linear dual of k^n when $n > 2$; and M is an irreducible module of dimension not bigger than 3 when $n = 2$. We then investigate the geometry of enhanced nilpotent orbits when the finiteness occurs. Our focus is on the enhanced group $\mathbf{G} = \mathrm{GL}(V) \ltimes_\eta V$ with the natural representation (η, V) of $\mathrm{GL}(V)$, for which we give a precise classification of finite nilpotent orbits via a finite set P_n of so-called enhanced partitions of $n = \dim V$, then give a precise description of the closures of enhanced nilpotent orbits via constructing so-called enhanced flag varieties. Finally, the $\mathbf{G}$*-equivariant intersection cohomology decomposition on* the nilpotent cone of $\tilde{\mathfrak{g}}$ *along the closures of nilpotent orbits is established. This is a joint work with* Yunpeng Xue and Yufeng Yao.

Time: 7.17 (Friday), 16:20 – 17:20
Venue: Mingde Building B201-1

Classification of irreducible ordinary modules for affine vertex superalgebras

Qing Wang

Xiamen University

Abstract: In this talk, we present our recent results on the classification of irreducible ordinary modules for affine vertex superalgebras at boundary admissible level. This is a joint work with Huaimin Li.

Time: 7.18 (Saturday), 8:30 – 9:30
Venue: Mingde Building B201-1

A monoidal categorical approach to augmented Rota-Baxter algebras and free cocycle bialgebras

Yi Zhang
Nanjing University of Information Science and Technology

Abstract: The ordinary tensor product of Rota-Baxter operators is not stable and therefore does not provide a natural monoidal structure on the category of Rota-Baxter algebras. We resolve this obstruction by passing to augmented Rota-Baxter algebras and by introducing a triangular tensor product governed by the augmentation. This construction makes the category of augmented Rota-Baxter algebras into a monoidal category. We identify its comonoid objects with Rota-Baxter cocycle bialgebras, thereby giving a categorical explanation for the Hochschild 1-cocycle condition. As an application, we construct a canonical bialgebra structure on the free commutative Rota-Baxter algebra generated by a commutative bialgebra, prove its universal property as a free commutative Rota-Baxter cocycle bialgebra, and obtain a Hopf algebra in the connected filtered case.

Time: 7.18 (Saturday), 9:50 – 10:50
Venue: Mingde Building B201-1

Compatible Lie conformal bialgebras

Lamei Yuan
Harbin Institute of Technology

Abstract: In this talk, we introduce compatible Lie conformal bialgebras. Such a structure consists of two compatible Lie conformal brackets and two compatible conformal cobrackets on the same $\mathbb{C}[\partial]$-module, and every simultaneous linear combination of them is again a Lie conformal bialgebra. We study representations and matched pairs for compatible Lie conformal algebras, introduce compatible Lie conformal coalgebras, and establish their duality through the conformal dual in the finite case. For $\mathbb{C}[\partial]$-modules that are free of finite rank, we prove the equivalence among compatible Lie conformal bialgebras, standard compatible conformal Manin triples and matched pairs. In the coboundary case, we characterize the tensors r that determine compatible Lie conformal bialgebras. The characterization requires the symmetric part of r to be invariant with respect to both brackets and three conformal Yang–Baxter conditions to hold. The first two conditions correspond to the two brackets separately, whereas the third is the compatible conformal Yang–Baxter condition. For comparison, we introduce the compatible conformal classical Yang–Baxter equation and show that each of its solutions satisfies these three conditions, while the converse fails. Several examples are given. This is a joint work with Jiansen Zhao.

Time: 7.18 (Saturday), 10:50 – 11:50
Venue: Mingde Building B201-1

Classification of simple Harish-Chandra modules over some Lie superalgebras

Dong Liu
Huzhou Normal University

Abstract: In this talk, we introduce some progresses on classifications of simple Harish-Chandra modules over some Lie superalgebras, including the super Virasoro algebra, the N = 2 superconformal algebras, the super Weyl algebra, etc.

Time: 7.18 (Saturday), 14:00 – 15:00
Venue: Mingde Building B201-1

Simple modules of a class of simple Lie superalgebras in prime characteristic

Yufeng Yao
Shanghai Maritime University

Abstract: Let $\mathbb{F}$ be an algebraically closed field of prime characteristic $p > 3$. Let n be a positive integer, and $\mathfrak{A}(n) = \mathbb{F}[x]/(x^{p^n})$, $\Lambda(1) = \mathbb{F}[\xi]/(\xi^2)$ be the divided power algebra of one variable and the Grassmann superalgebra of one variable, respectively. The Zassenhaus superalgebra $\mathcal{Z}(n)$, the first non-restricted simple Lie superalgebra, is by definition the Lie superalgebra of the special super derivations of the superalgebra $\Pi(n) = \mathfrak{A}(n) \otimes_{\mathbb{F}} \Lambda(1)$, and contains a simple subalgebra $\mathcal{D}(n)$. In this talk, we study simple $\mathcal{D}(n)$-modules with p-characters of height no more than one. We give a complete classification of the isomorphism classes of such simple modules and determine their dimensions. Moreover, a sufficient and necessary condition for the irreducibility of Kac modules is provided. This is a joint work with Yilin Zhou.

Time: 7.18 (Saturday), 15:20 – 16:20
Venue: Mingde Building B201-1

Recent results on evolution algebras

Amir Fernández Ouaridi
Universidad de Sevilla, Spain

Abstract: Evolution algebras are a class of commutative non-associative algebras defined by the existence of a natural basis, and they can be naturally described in terms of weighted directed graphs. In this talk, we present several recent results concerning the algebraic and geometric structure of these algebras. We first study polynomial identities and the position of evolution algebras inside the variety of commutative algebras. We then introduce evolution envelopes, a construction that allows finite-dimensional commutative algebras to be embedded into evolution algebras while preserving important structural properties. Finally, we discuss the connection between minimal evolution envelopes and simultaneous Waring decompositions of quadratic maps, providing a link between non-associative algebra and decomposition theory.

Time: 7.18 (Saturday), 16:20 – 17:20
Venue: Mingde Building B201-1