

Titles and Abstracts

Embeddings of symmetric spaces

Huanchen Bao (NUS)

Abstract: Let G_k be a connected reductive group over an algebraically closed field k of char $\neq 2$. Let θ_k be an involution of G_k , and denote the fixed point subgroup by K_k . The affine quotient G_k/K_k is called a symmetric space. For example, we can consider the reductive group $G_k \times G_k$ and the fixed point subgroup $\Delta(G_k)$ (the diagonal G_k). Then G_k is itself a symmetric space. An embedding of G_k/K_k is a normal G_k -variety V_k together with a G_k -equivariant open embedding $G_k/K_k \hookrightarrow V_k$. For example, the variety of $n \times n$ matrices is an embedding of the general linear group GL_n over k .

In this talk, we discuss a quantization and an integral model of any affine embeddings of the symmetric space G_k/K_k . We show that the coordinate ring of any affine embedding of G_k/K_k admits a dual canonical basis. We further construct an integral model for the canonical embedding (that is, an embedding which is complete, simple, and toroidal) of G_k/K_k . When G_k is of adjoint type, we obtain an integral model for the wonderful compactification of the symmetric space. This is based on joint work with Jinfeng Song.

Whittaker modules and representations of finite W-algebras of queer Lie superalgebras

Shun-Jen Cheng (Academia Sinica)

Abstract: We study various categories of Whittaker modules over the queer Lie superalgebras. We formulate standard Whittaker modules and reduce the problem of composition factors of these standard Whittaker modules to that of Verma modules in the corresponding BGG categories. We establish equivalence of categories between the categories of Whittaker modules and analogues of BGG category of finite W-algebra modules over the queer Lie superalgebra. This enables us to compute the composition factors of Verma modules over these finite W-algebras. This is based on joint work with Chih-Whi Chen.

Magical triples and their ramifications

Enya Hsiao (Max-Planck Institute)

Abstract: In recent years, the notion of magical sl_2 triples introduced by Bradlow—Collier—García-Prada—Gothen—Oliveira has provided a unifying framework in detecting special components in the Higgs bundle moduli space that correspond, under the nonabelian Hodge correspondence, to surface group representations of interest in the character variety. In this talk, I will explain how their work extends to a morphism of BAA-branes on Higgs stacks, and our understanding of their BBB-brane duals in certain cases. This is joint work with Eric Chen and Mengxue Yang.

Pro- p metaplectic Hecke algebras and quantum wreath products

Chun-Ju Lai (Academia Sinica)

Abstract: We provide a transparent presentation of the pro- p Hecke algebra for the n -th metaplectic cover of the p -adic group $GL_d(F)$ using the theory of quantum wreath products, for which the base algebra is a ring of skew polynomials. We prove a splitting lemma for the quadratic relations, allowing for the new definition of a non-trivial analog of the trivial and sign modules. Utilizing this structure, we realize the pro- p component of the Gelfand-Graev representation using wreath modules explicitly, and then construct a Schur algebra with explicit Dipper-James basis and multiplication formulas. Our results also recover the following, as special cases: (1) The Kashiwara-Miwa-Stern tensor space as a module of the affine Hecke algebra, (2) The realization of Vigneras' pro- p Hecke algebra as the affine Yokonuma Hecke algebra, (3) The identification with the affine q -Schur algebras using the Iwahori component of the Gelfand-Graev representation due to Gao, Gurevich and Karasiewicz, (4) The local Shimura correspondence at the Iwahori level between the linear and the metaplectic case. This is a joint work with Valentin Buciumas (PoSTech).

Drinfeld presentation of twisted Yangians and applications

Kang Lu (SUSTech)

Abstract: In recent joint work with Weiqiang Wang and Weinan Zhang, we have obtained Drinfeld-type current presentations for twisted Yangians of type AI and beyond. These presentations are realized through Gauss decomposition and the degeneration of affine iquantum groups. In this talk, I will discuss recent progress in the study of these twisted Yangians (iYangians) and their applications. Key topics include their coideal structure, their shifted generalizations, and their connections to finite W -algebras of classical types and affine Grassmannians islices (if time permits).

This talk is based on joint works with Yung-Ning Peng, Lukas Tappeiner, Lewis Topley, Weiqiang Wang, and Weinan Zhang.

Quantum symmetric pairs via Hall algebras

Ming Lu (Sichuan University)

Abstract: A quantum symmetric pair consists of a quantum group $\mathbf{U}$ and its coideal subalgebra $\mathbf{U}^i$. The Hall algebra constructions of $\mathbf{U}$ and $\mathbf{U}^i$ are given by Bridgeland and Lu-Wang, respectively. In this paper, we construct a Hall algebra framework for the coideal subalgebra structure of $\mathbf{U}^i$ in $\mathbf{U}$, and for the quantum symmetric pair $(\mathbf{U}, \mathbf{U}^i)$. As an application, we prove that the natural embedding of $\mathbf{U}^i$ in $\mathbf{U}$, and the coproduct preserve the integral forms of $\mathbf{U}^i$ and $\mathbf{U}$, which are used to construct the dual canonical bases. This is joint with Zhuoyi Zhao.

Representation theory of quantum loop algebras via freezing operators

Fan Qin (Beijing Normal University)

Abstract: Guided by an extension–reduction strategy, we study the (q, t) -characters of finite-dimensional simple modules using freezing operators, which arise from the theory of cluster algebra. This allows us to prove the Hernandez conjecture (an analog of Kazhdan–Lusztig conjecture) for type B and C. This is based on a joint work with Ryo Fujita.

Representations for Toroidal Elliptic Lie Algebras

Shaobin Tan (Xiamen University)

Abstract: Elliptic Lie algebras are nullity two extended affine Lie algebras, which are generalization of the affine Kac-Moody Lie algebras. Toroidal elliptic Lie algebras are important class of elliptic Lie algebras. In this talk we will deal with the classification of irreducible integrable representations for the toroidal elliptic Lie algebras.

Positivity properties of canonical bases

Jiepeng Fang (HKU)

Abstract: We prove that the canonical basis of a modified quantum group $\dot{\mathbf{U}}$ of symmetric type exhibits strong positivity properties for the canonical basis elements arising from spherical parabolic subalgebras. Our main result establishes that the structure constants for both the multiplication with arbitrary canonical basis elements in $\dot{\mathbf{U}}$ and the action on the canonical basis elements of arbitrary tensor products of simple lowest and highest weight modules by these elements belong to $\mathbb{N}[v, v^{-1}]$. This implies, in particular, for any quantum group, the structure constants for action on simple modules with respect to canonical basis are governed by positive coefficients; and for

quantum groups of finite type, the structure constants for multiplication and for action on tensor product with respect to canonical basis are governed by positive coefficients. A key ingredient is the thickening construction, an algebraic technique that embeds a suitable approximation of the tensor of a lowest weight module and a highest weight module of $\dot{\mathbf{U}}$ into the negative part $\tilde{\mathbf{U}}^-$ of a larger quantum group. This allows us to inherit the desired positivity for the tensor product from the well-established positivity of the canonical basis of $\tilde{\mathbf{U}}^-$. This is a joint work with Xuhua He.

Canonical bases and Mordell-Schinkel surfaces

Antoine de Saint Germain (HKU)

Abstract: Since their introduction by G. Lusztig in the early 1990s, canonical bases have been the subject of much study. In this talk, I will explain how to use the properties of canonical bases in cluster varieties to resolve a Diophantine problem for so-called Mordell-Schinkel surfaces. This is partly based on joint work with Robin Zhang (MIT).

Quantum symmetric pairs at roots of unity

Weinan Zhang (HKU)

Abstract: The representation theory of quantum groups at roots of unity was developed by De Concini-Kac-Procesi in series of works, and this has applications and connections in modular representations, Poisson geometry, and geometric representation theory. In this talk, we generalize the approach of De Concini-Kac-Procesi to quantum symmetric pairs. Let θ be an involution on a Lie algebra $\mathfrak{g}$. We construct a Frobenius center for the associated quantum group U_v^θ at odd roots of unity, and show that the irreducible representations of U_v^θ are parametrized by θ -twisted conjugacy classes of the Lie group G . We determine the degree of U_v^θ and study its Azumaya locus, as well as branching problems. This is based on a joint work with Jinfeng Song.

Total positivity in twisted flag varieties

Kaitao Xie (HKU)

Abstract: Motivated by the study of totally nonnegative double flag variety and totally nonnegative reduced double Bruhat cells, we introduce the notion of twisted flag varieties, which is a generalization of the flag variety of a Kac-Moody group. In this talk, I will discuss some results on the totally nonnegative twisted flag varieties and some applications, as well as the connections to the theory of canonical basis. This is based on a joint work with Xuhua He.