Alterfold Theory and Modular Invariance

Zhengwei Liu（刘正伟）
Tsinghua University and BIMSA

We will present new insights in alterfold theory to study modular tensor categories. We provide streamlined quick proofs and broad generalizations of a wide range of results on modular invariants of modular tensor categories. It is based on joint work with M. Shuang, Y. Wang and J. Wu, arXiv:2412.12702.

A Cluster-Theoretic Approach to Polynomial Equations II

Fang Li（李方）
Zhejiang University

3 Key words: Diophantine equation, polynomial equation, cluster algebra

In this talk, we will introduce the method of cluster symmetry motivated by cluster algebras and apply it to discuss the solutions of polynomial equations over either the ring of integer numbers or a finite field, and the positive integer solutions of Diophantine equations.

Towards Triangulated birepresentations: Evaluation and Induction in Soergel Categories

Pedro Vaz
Université catholique de Louvain

3 Key words: Soergel categories, Evaluation and induction functors, birepresentations

Evaluation representations and parabolic induction play a central role in the finite-dimensional representation theory of extended affine type A Hecke algebras. In this talk I will explain joint work with Marco Mackaay and Vanessa Miemietz in which we begin to categorify these classical constructions inside the tensor-categorical setting of extended affine type A Soergel categories. I will first describe evaluation functors that lift the usual evaluation maps and give rise to triangulated birepresentations admitting finitary covers. I will then present a categorified version of Zelevinsky's parabolic induction based on a monoidal functor between suitable homotopy categories. Throughout I will highlight explicit diagrammatic constructions and examples, as well as the open questions surrounding triangulated birepresentations and their extensions beyond type A.

Representation type of Hopf algebras with dual Chevalley property

Gongxiang Liu（刘公祥）
Nanjing University

3 Key words: Representation type, Chevalley property, Quiver

In this talk, we try to talk about the structures of Hopf algebras with Chevalley property of finite, tame and discrete corepresentation typies. As consequences, we find some new Hopf algebras. Some questions are also given. This is a joint work with Dr. Yu Jing.

Two-parameter Topological Quantum Groups and Their Universal R-matrices

Naihong Hu（胡乃红）
East China Normal University

3 Key words: Two-parameter topological quantum groups, universal R-matrix, quantum trace

Constructing the universal R-matrices for two-parameter quantum groups has been a long-standing open problem in two-parameter quantum groups theory. To this end, we first introduce and define the (h,h')-adic topological two-parameter quantum group $U_{h,h'}(\mathfrak{g})$ associated to a simple Lie algebra, and obtain an explicit expression of the universal R-matrix. This lays a rigorous and unified foundation for the quasitriangular structure of two-parameter quantum groups and their braided tensor categories. Its construction relies on two key combinatorial techniques we developed. The resulting ones when the universal R-matrices restrict to their respective fundamental representations, uniformly reproduces those basic R-matrices obtained by previous researchers for all classical types of two-parameter quantum groups, including type A [Benkart-Witherspoon], type B [Hu-Xu-Zhuang], type C [Zhong-Hu-Jing] and type D [Zhuang-Hu-Xu]. It also directly yields the relevant results for type G_2 [Wang-Hu]. As applications, using the weight module projection operators, we construct a series of central elements z_λ. We find that these elements are completely identical to the central elements c_λ [Hu-Wang 25] determined by the quantum trace realized on a given weight module $L(\lambda)$ via the Rosso form, thus refining the Harish-Chandra center theory. Hopefully, this work will provide algebraic tools for further investigating new low-dimensional topological invariants (e.g., RT invariants, MOY-Kuperberg theory) and integrable systems (quantum 6-j symbols) related to two-parameter quantum groups. This is a joint work with Marc Rosso and Hengyi Wang.

Equivariant cohomology of Kleinian resolutions and the quantum Hikita conjecture

Xiaojun Chen（陈小俊）
New Uzbekistan University/Sichuan University

3 Key words: Kleinian singularity, quantum cohomology, Hikita conjecture

In the past two decades 3d N=4 mirror symmetry has been widely studied by physicists and mathematicians. It is also closely related to symplectic duality proposed by Braden et al. One of the conjectures in this field, initiated by Hikita, says that the cohomology of one symplectic manifold is isomorphic to the coordinate ring of the torus-fixed scheme of its symplectic dual. In this talk we show a equivariant/quantum version of Hikita's conjecture between Kleinian singularities and the corresponding Slodowy slices. This talk is based on a joint work with He and Yu from Sun Yat-sen University.

Automorphisms of vertex operator algebras

Chongying Dong（董崇英）
University of California, Santa Cruz

3 Key words: automorphisms, fusion category, G-extnsions

I will report on our recent progress in the study of automorphism groups of vertex operator algebras: (1) If a VOA A is an extension of a VOA V, where V is a "nice" VOA, then the corresponding Galois group $\mathrm{Gal}(A/V)$ is a finite group. (2) We establish a connection between $\mathrm{Gal}(A/V)$ and $\mathrm{Gal}(A/V)$-extension of the A-modules in categorical setting. This is a joint work with Richard Ng, Li Ren, Feng Xu.

On tensor decompositions

Hua-Lin Huang（黄华林）
Huaqiao University

3 Key words: Tensors, additive and multiplicative decompositions, Waring's problem of polynomials

The problem of tensor decompositions primarily focuses on expressing complex tensor elements as sums or products of simpler tensors. This report will introduce a brief history of the topic, important results, and existing problems, while also presenting some research progress.

Representations of Quantum Affine General Linear Superalgebras at Arbitrary 01-Sequences

Honglian Zhang（张红莲）
Shanghai University

3 Key words: Quantum affine superalgebras; RTT presentation; finite-dimensional irreducible representations; evaluation representations.

In this paper, we investigate finite-dimensional irreducible representations of the quantum affine general linear superalgebra $U_q(\widehat{gl}_{m|n,s})$ for arbitrary 01-sequences, using the RTT presentation. We

systematically construct the RTT presentation for quantum general linear superalgebra $U_q(\widehat{gl}_{m|n,s})$, and derive a PBW basis induced by the action of the braid group, compatible with non-standard parities. We determine the necessary and sufficient conditions for the finite-dimensionality of irreducible representations of $U_q(\widehat{gl}_{m|n,s})$ and extend the results to the affine case via the evaluation homomorphism. Specific cases such as $(m,n)=(1,1)$ demonstrate that all finite-dimensional representations are tensor products of typical evaluation representations. This work extends existing representation frameworks and classification methods to encompass arbitrary 01-sequences, establishing the foundation for subsequent research on representations of quantum affine superalgebras.

Pointed Hopf algebras of odd dimension

István Heckenberger
Marburg University

3 Key words: Hopf filtrations, Nichols algebras, solvable groups

In joint work with Andruskiewitsch and Vendramin we proved that over algebraically closed fields of characteristic zero, pointed Hopf algebras of odd dimension are cocycle deformations of bosonizations of Nichols algebras of diagonal type. The proof is based on deep results of several people about pointed Hopf algebras with abelian coradical, and on a new deformation argument for solvable groups. I will explain the notions in the theorem and give some details about the proof.

Generalizations of Frobenius-Schur indicators from invariants of 3-manifolds

Siu-Hung Ng（吴少雄）
Louisiana State University

3 Key words: Frobenius-Schur indicator, Gauge Invariant, 3-manifold invariant

In this talk, we introduce some generalizations of higher Frobenius-Schur indicators of Hopf algebras from Kuperberg invariants of framed 3-manifolds.The higher Frobenius-Schur indicators for semisimple Hopf algebras over complex numbers are indeed Kuperberg invariants of lens spaces. However, these Kuperberg invariants for nonsemisimple Hopf algebras involve some higher powers of the antipode which are completely determined by the framed lens spaces. Moreover, these generalizations of Frobenius-Schur indicators from framed lens spaces and some genus 2 framed 3-manifolds are shown to the be invariants of the tensor categories of representations of the underlying Hopf algebras. This talk is based on a joint work with Liang Chang and Yilong Wang.

Separable algebras in higher fusion categories

Hao Zheng（郑浩）
Tsinghua University

Higher condensation theory for topological orders appeals to a theory of E_k-algebras in higher E_m-multi-fusion categories. The conventional definition of E_k-algebras employs operadic language. The physical intuition of topological orders reveals an alternative way to define E_k-algebras. In this talk, we introduce this new approach to the problem and discuss the representation theory of E_k-algebras.

Homological spectra of monoidal triangulated categories

Milen Yakimov
Northeast University

3 Key words: Stable module categories, Balmer spectra, homological primes of Freyd envelopes

Monoidal triangulated categories arise in many areas of mathematics and mathematical physics. For instance, the stable module category of any finite dimensional Hopf algebra (and more generally, of any finite tensor category) is of this type and is not braided in general. A key topological space associated to a monoidal triangulated category is its noncommutative Balmer spectrum. An important problem is to classify it for which one of the main approaches is through a support map satisfying the noncommutative tensor product property. The only known such maps are Carlson's rank support for finite groups and the Friedlander-Pevtsova pi-points for finite group schemes. In the symmetric case, Balmer developed the notion of homological support as a tool to address the problem in general. We will describe a very nontrivial extension of this notion to arbitrary monoidal triangulated categories and illustrate how it works in interesting examples. Many new phenomena arise in the (noncommutative) nonsymmetric case.

Casimir and polynomial invariants of Hopf algebra

Libin Li（李立斌）
Yangzhou University

3 Key words: Hopf algebra, Casimir invariant, polynomial invariant

In this talk, we first discuss the Casimir number for the representation category of a finite representation type Hopf algebra. And then we investigate a relationship between the n-th Sweedler power maps on integrals of Hopf algebra and its twisted Hopf algebra. We use this relation to give several polynomial invariants of the representation category of Hopf algebra considered as a tensor category. As applications, we distinguish the representation categories of 12-dimensional pointed non-semisimple Hopf algebras. Also, these polynomial invariants are sufficient to distinguish the representation categories of 8-dimensional semisimple Hopf algebras.

Monoidal categories graded by 2-groups

Alexis Virelizier
Université de Lille

I will introduce the notion of a monoidal category graded by a 2-group. Encoding the 2-group by a crossed module $\chi : E \to H$, the objects of such a category have a degree in H and the morphisms have a degree in E (which are related via χ). I will also introduce Hopf χ-(co)algebras, which generalize Hopf algebras and Hopf group-(co)algebras, and whose categories of representations are χ-graded monoidal. The motivation for the introduction of 2-group-graded monoidal categories is that they are useful to construct 3-dimensional homotopy field theories with target a homotopy 2-type, which in particular give rise to invariants of flat 2-bundles over 3-manifolds.

Classification of exchange relation planar algebras through sieving forest fusion graphs

Fan Lu（陆凡）
BIMSA

We develop a structural classification theory for exchange relation planar algebras up to rank six, and at this critical rank we discover infinitely many new infinite depth subfactors. A central result is an equivalence between exchange relation and forest fusion graphs, which reduces the classification problem to the analysis of finite forest data. Using this framework, we implement an automated procedure that enables the examination of approximately 68 billion graph configurations and the verification of the associated consistency equations. Finally, we establish reflection positivity for the resulting family of planar algebras, ensuring that they arise from genuine subfactors.

Tensor network states and spherical bicategories

Jürgen Fuchs
Karlstad University

3 Key words: Projected entangled pair states, Matrix product operators, spherical bicategories

An important class of quantum states in tensor networks are the Projected Entangled Pair States (PEPS), and symmetries of PEPS in a two-dimensional tensor network can be encoded by Matrix Product Operators (MPO). Apart from the physical state space at the lattice sites, the definition of PEPS and MPO also involves auxiliary vector spaces.

I will explain how additional structure on those spaces can be understood in terms of a 2-object spherical bicategory that involves two monoidal categories and two bimodule categories over them. The mathematical structure of symmetries for two-dimensional PEPS is thus bicategorical. Conversely, tensor network techniques provide a computational handle on bicategorical structures.

Equivariant K-theoretic construction of multi-parameter affine quantum Schur algebras and iquantum groups

Li Luo（罗栗）
East China Normal University

We present an equivariant K-theoretic construction of affine quantum Schur algebras of type BCFG with three or two parameters by taking advantage of Kato and Antor's exotic framework. This enables the derivation of an equivariant K-theoretic realization of multi-parameter affine iquantum groups of type AIII. This is joint work with Zheming Xu and Yang Yang.

Generalized symmetries from fusion actions

Li Ren(任丽)
Sichuan University

3 Key words: VOA, fusion action, duality

I will discuss our recent investigation into the generalized symmetries of condensable algebras in modular tensor categories. The mian results inculde Schur-Weyl duality, Galois correspondence and generalized orbifold theory for vertex operator algebras. This is a joint work with Chongying Dong, Siu-Hung Ng and Feng Xu.

Semisimple Yetter-Drinfel'd Hopf Algebras

Yorck Sommerhäuser
Memorial University of Newfoundland

3 Key words: Hopf algebra, Yetter-Drinfel'd Hopf algebra, semisimple

Yetter-Drinfel'd Hopf algebras arise in the theory of ordinary Hopf algebras when trying to decompose Hopf algebras into the analogue of a semidirect product, the so-called Radford biproduct. A Radford biproduct is semisimple if and only if its two factors, one of which is a Yetter-Drinfel'd Hopf algebra, are semisimple. To understand semisimple Hopf algebras via this approach, it is therefore necessary to study also semisimple Yetter-Drinfel'd Hopf algebras. However, even some basic questions that are well understood for semisimple Hopf algebras remain unanswered for semisimple Yetter-Drinfel'd Hopf algebras. In the talk, we will survey some aspects of the research on these questions over the last decades.

Clifford deformations and Knorrer Periodicity Theorem

Jiwei He（何济位）
Hangzhou Normal University

Let A and B be Koszul Artin-Schelter regular algebras such that $A \otimes B$ is Noetherian. We employ the Clifford deformation to study the singularities of the Sebastiani-Thom sum denoted as $R = A \otimes B/(f \otimes 1 + 1 \otimes g)$, where both $f \in A$ and $g \in B$ are central regular elements of degree 2. It is proved that R is a graded isolated singularity if and only if both $A/(f)$ and $B/(g)$ are graded isolated singularities.

The concept of a simple graded isolated singularity is introduced, along with a criterion that characterizes whether a quadratic hypersurface arising from a skew polynomial algebra is a simple graded singularity of type 0 or type 1. Then we generalize Knörrer's periodicity beyond commutative quadrics, expressed through triangle equivalences:

$\underline{\mathrm{mcm}}R \cong \underline{\mathrm{mcm}}(A/(f))$ when $B/(g)$ is a simple graded isolated singularity of type 0,where $\underline{\mathrm{mcm}}$ denotes the stable category of maximal Cohen-Macaulay modules; and $\underline{\mathrm{mcm}}R \cong \mathbf{D}^b\,(\mathrm{mmod}\, C_{A^!}\,(\theta_f))$ when $B/(g)$ is a simple graded isolated singularity of type 1, where $C_{A^!}(\theta_f)$ is the Clifford deformation associated with $A/(f)$.

As an application, for any noncommutative conic $A/(f)$, a triangle equivalence is established:

$\underline{\mathrm{mcm}}\left((A/(f))^{\#}\right) \cong \underline{\mathrm{mcm}}(A/(f)) \times \underline{\mathrm{mcm}}(A/(f))$ where $(A/(f))^{\#} = A[x]/(f + x^2)$ represents the double branched cover.

Finite GK-dimensional Nichols algebras of twisted Yetter-Drinfeld modules over finite abelian groups.

Yuping Yang（杨毓萍）
Southwest University

3 Key words: Nichols algebra, quasi-Hopf algebra, GK-dimension

In this talk, we will present a classification of Nichols algebras with finite Gelfand-Kirillov (GK) dimension in the category of twisted Yetter-Drinfeld modules over finite abelian groups. These Nichols algebras arise naturally in the classification problem of pointed coquasi-Hopf algebras over finite abelian groups. Let ${}^{kG}_{kG}\mathcal{YD}^{\Phi}$ be a twisted Yetter-Drinfeld modules category, where G is a finite abelian group, Φ is a normalized 3-cocycle on G, and k is an algebraically closed field of characteristic zero. We first discuss Nichols algebras of nondiagonal type in ${}^{kG}_{kG}\mathcal{YD}^{\Phi}$ and show that all such nondiagonal Nichols algebras have infinite GK-dimension. Furthermore, we prove that a Nichols algebra in ${}^{kG}_{kG}\mathcal{YD}^{\Phi}$ has finite GK-dimension if and only if it is of diagonal type and its corresponding root system if finite, i.e., an arithmetic root system.

New classes of Quasi-Hopf algebras

Blas Torrecillas
University of. Almeria

3 Key words: Quasi-Hopf algebras, double biproduct

Using a two cocycle deformation of a double biproduct of quasi-Hopf algebras we will construct a new classes of quasi-Hopf algebras similar to the Drinfeld-Jimbo quantum groups. The talk gives a summary of an ongoing collaboration with Daniel Bulacu.

Derived representation schemes and derived Schur algebras

Farkhod Eshmatov
New Uzbekistan University

For an associative algebra, its n-dimensional representations are represented by an affine scheme, called the representation scheme. About 15 years ago, Berest-Khachatryan-Ramadoss showed that the representation functor has a derived functor, and the n-dimensional derived representations of a DG algebra are represented by the so-called derived representation scheme. In particular, they showed that the classical trace map, now on the derived level, naturally maps the cyclic homology of the algebra to homology of its derived representation scheme. In this talk, we will discuss a "nonabelian" generalization of the above result. More precisely, we show that for a DG algebra, its "derived" multiplicative laws exist, and are represented by the "derived" Schur algebra; moreover, the derived functions on the derived Schur algebra, which we call the higher order cyclic complex of the algebra, are naturally mapped to the DG algebra of the derived representation schemes via the higher order trace map (Joint work with Xiaojun Chen)

On the finite generation of the cohomology of bosonizations

Xingting Wang（汪兴庭）
Louisiana State University

3 Key words: Hopf algebras, cohomology, smash products

In support varieties for finite tensor categories, Etingof and Ostrik conjectured that the cohomology rings of these categories are always finitely generated. In this talk, we build on the work of Negron and Pevtsova by using sequences of Hopf algebras to demonstrate that bosonizations of certain graded Hopf algebras, combined with specific finite-dimensional Hopf algebras, result in finitely generated cohomology. This is joint work with Nicolas Andruskiewitsch, David Jaklitsch, Van Nguyen, Amrei Oswald, Julia Plavnik, and Anne Shepler.