QUASY-CON II
TITLES AND ABSTRACTS

(Last updated 4 May 2024)

Elise Askelsen, *Hopf actions of Hopf-Ore extensions of group algebras on path algebras:*

The classical notion of symmetry can be encoded using the language of group actions. Actions of Hopf algebras encode a generalized notion of symmetry. In this talk, I will present my recent work to parameterize Hopf actions of Hopf-Ore extensions of group algebras on path algebras.

Nicolas Bridges, *A Generalization of two invariants of three-manifolds from involutory Hopf algebras:*

We introduce an invariant of a pair (M,L) consisting of a closed connected oriented three-manifold and a framed oriented link embedded in M which is a generalization of the Kuperberg invariant and the Hennings-Kauffman-Radford invariant. The invariant has the data of an involutory Hopf algebra and a collection of representations of the Drinfel'd double: one for each link component. More precisely, we show that if L is the empty link, then the invariant is equivalent to the Kuperberg invariant for the manifold M, and if M is the 3-sphere and the representations are the left regular representations of the double, then the invariant is equivalent to the HKR invariant.

Shawn Cui, *Trisection invariants of 4-manifolds from Hopf algebras:*

The Kuperberg invariant is a topological invariant of closed 3-manifolds based on finite-dimensional Hopf algebras. Here we initiate the program of constructing 4-manifold invariants in the spirit of Kuperberg's 3-manifold invariant. We utilize a structure called a Hopf triplet, which consists of three Hopf algebras and a bilinear form on each pair subject to certain compatibility conditions. In our construction, we present 4-manifolds by their trisection diagrams, a four-dimensional analog of Heegaard diagrams. The main result is that every Hopf triplet yields a diffeomorphism invariant of closed 4-manifolds. In special cases, our invariant reduces to Crane-Yetter invariants and generalized dichromatic invariants, and conjecturally Kashaev's invariant. As a starting point, we assume that the Hopf algebras involved in the Hopf triplets are semisimple. Time permitting, we also talk about generalizations using non-semisimple Hopf algebras.

Alexei Davydov, *Deformation cohomology of Schur-Weyl categories:*

The deformation cohomology of a tensor category controls deformations of its associativity constraint. Here we deal with the deformation cohomology of tensor categories generated by one object (the so-called Schur-Weyl categories). This approach is convenient for computing the deformation cohomology of free symmetric tensor categories. We compare the answers with the exterior invariants of the general linear Lie algebra. The results make precise an intriguing connection between the combinatorics of partitions and invariants of the exterior powers of the general linear algebra observed by Kostant.

Jonas Hartwig, *Symplectic differential reduction algebra:*

Differential reduction algebras are associated to oscillator representations of a Lie (super)algebra. They act on multiplicity spaces in infinite dimensional tensor products and are h-deformations of the Weyl/Clifford superalgebras. They are also connected to solutions of the dynamical Yang-Baxter equation. I will report on joint work with Dwight Williams II, in which we compute a presentation the reduction algebra in the case of the symplectic Lie algebra sp(4). The algebras turn out to be generalized Weyl algebras and thus their irreducible representations are known. The case of gl(n) has been studied previously by Herlemont, Khoroshkin, and Ogievetsky.

Vijay Higgins, *Central elements in the $SL(d)$ skein algebra:*

The skein algebra of a surface is spanned by links in the thickened surface, subject to skein relations which diagrammatically encode the data of a quantum group. The multiplication in the algebra is induced by stacking links in the thickened surface. This product is generally noncommutative. When the quantum parameter q is generic, the center of the skein algebra is essentially trivial. However, when q is a root of unity, interesting central elements arise. When the quantum group is quantum $SL(2)$, the work of Bonahon-Wong shows that these central elements can be obtained by a topological operation of threading Chebyshev polynomials along knots. In this talk, I will discuss joint work with F. Bonahon in which we use analogous multi-variable 'threading' polynomials to obtain central elements in higher rank $SL(d)$ skein algebras.

Gerald Höhn, *Classification of self-dual vertex operator superalgebras of central charge at most 24:*

I will discuss recent joint work with Sven Möller on the construction and classification of self-dual vertex operator superalgebras of central charge up to 24. We employ the 2-neighbourhood graph of the self-dual VOAs of central charge 24 and realize these SVOAs as simple-current extensions of a dual pair. This pair includes a VOA derived from the Leech lattice alongside a lattice VOA. We have identified exactly 969 such SVOAs. The remaining open question concerns the uniqueness of the shorter Moonshine module, which was the subject of my 1995 Ph.D. thesis.

Pradyut Karmakar, *TBA:*

TBA

Ralph Kaufmann, *Twisting geometrically, algebraically and categorically.:*

For the purposes of twisted orbifold Gromov-Witten and K-theory, we defined twisting data, which is called discrete torsion and gerbe twisting. These both have algebraic incarnations which can be explained using the twisted Drinfel'd double of a group algebra. There are several levels of twistings which we will cover. Finally, we will argue that the geometric gerbe twisting can be rephrased as a categorical twisting.

Ryan Kinser, *Hopf actions and algebras in tensor categories:*

The classical notion of group actions (symmetries) has a natural generalization as Hopf algebra actions (quantum symmetries). At the same time, the classical study of finite-dimensional associative algebras has a natural generalization to algebras in finite tensor categories. This talk will be an introductory overview of these concepts, along with some proposed ideas for extending the fundamentals of the theory of finite dimensional algebras to the setting of finite tensor categories.

Zongzhu Lin, *Differential graded vertex Lie algebras:*

In an earlier paper, we have defined differential graded vertex algebras, motivated from Joyce's construction of vertex algebras from moduli stacks of representations of quivers. No examples were given, in this talk we will follow the general construction of affine vertex algebras, to construct differential grade vertex algebras from differential graded vertex Lie algebras. Differential graded vertex Lie algebras can be constructed from affinization of differential graded Lie algebras.

Florencia Orosz Hunziker, *Graded traces, graded pseudo-traces and modularity:*

Modular forms played a fundamental role in the birth (McKay 1978) and proof (Borcherds 1992) of the Monstrous Moonshine conjecture. Building on this bridge between number theory and infinite dimensional Lie algebras, Zhu established in 1996 the modular invariance for the graded traces of any vertex operator algebra satisfying certain finiteness and semisimplicity conditions. In the non-semisimple but finite setting, Miyamoto more recently showed that in addition to the graded traces, one needs to incorporate other functions, called graded pseudo-traces, to obtain an $SL(2,\mathbb{Z})$ invariant space of (pseudo-)characters. In this talk I will present our recent results regarding the existence of graded pseudo-traces for strongly interlocked modules without any additional finiteness assumptions with a focus on applications to the representations of the Heisenberg and Virasoro vertex algebras. This talk is based on joint work with Barron, Batistelli and Yamskulna.

Christopher Raymond, *Inverting Hamiltonian reduction: an introduction:*

Logarithmic conformal field theories (logCFTS) are an exciting frontier in mathematical and theoretical physics. Many examples of logCFTs are described by vertex operator algebras (VOAs), in particular, affine and W-algebra VOAs. The representations of these algebras that play a role in logCFT are difficult to construct and understand. A new approach to constructing these representations has been developed, known as inverse hamiltonian reduction. The talk will motivate and provide an overview of inverse hamiltonian reduction for a broad audience using the simplest examples and discuss some state-of-the-art results if time permits.

Sean Sanford, *Invertible fusion categories:*

A tensor category $\mathcal{C}$ over a field $\mathbb{K}$ is said to be invertible if there is a tensor category $\mathcal{D}$ such that $\mathcal{C} \boxtimes \mathcal{D}$ is Morita equivalent to $\mathrm{Vec}_{\mathbb{K}}$. When $\mathbb{K}$ is algebraically closed, it is well-known that the only invertible fusion category is $\mathrm{Vec}_{\mathbb{K}}$, and any invertible multi-fusion category is Morita equivalent to $\mathrm{Vec}_{\mathbb{K}}$. By contrast, we show that for general $\mathbb{K}$, the invertible multi-fusion categories over $\mathbb{K}$ are classified (up to Morita equivalence) by $H^3(\mathbb{K}; \mathbb{G}_m)$, the third Galois cohomology of the absolute Galois group of $\mathbb{K}$. This group of invertible fusion categories is a higher-dimensional analogue of the Brauer group of $\mathbb{K}$ (which is isomorphic to $H^2(\mathbb{K}; \mathbb{G}_m)$).

As an application, we show that the Morita classification of fusion categories by their Drinfel'd centers breaks when $H^3(\mathbb{K}; \mathbb{G}_m)$ is nontrivial.

Jacob Van Grinsven, *Comodule algebras over H_8:*

An exact module category over $\mathrm{Rep}(H)$ categorifies the notion of a projective module over a ring. In characteristic 0, the classification of such categories is equivalent to the classification of right H-simple H-comodule algebras with trivial coinvariants. Such methods have been used successfully to characterize exact module categories when H is pointed. We discuss work to extend these results when H is not pointed.

Padmini Veerapen, *Manin's universal quantum groups under 2-cocycle twists:*

We examine 2-cocyle twists of a family of infinite-dimensional Hopf algebras, known as Manin's universal quantum groups, denoted by $\underline{\mathrm{aut}}(A)$, which Manin showed universally coact on connected graded quadratic algebras, A. In this talk, we consider $\underline{\mathrm{aut}}(A)$ under a more general setting, namely, when A is a finitely generated algebra subject to m-homogenous relations and show how $\underline{\mathrm{aut}}(A)$ can be twisted by 2-cocycles. This is joint work with H. Huang, V. C. Nguyen, C. Ure, K. B. Vashaw, and X. Want under an AIM SQuaRE grant.

Daniel Wallick, *Boundary algebras and local topological order:*

Topologically ordered quantum spin systems have become an area of great interest in part because the ground state space for these systems is a quantum error-correcting code. This is reflected in the axiomatization of topological order given by Bravyi, Hastings, and Michalakis. In this talk, we describe new local topological order axioms that strengthen those of Bravyi, Hastings, and Michalakis and give rise to a 1-dimensional net of boundary algebras. We provide an example satisfying these axioms, namely the Levin-Wen model corresponding to a unitary fusion category $\mathcal{C}$. We compute the boundary algebras for this model and show that they are given by $\mathrm{End}(X^{\otimes n})$, where X is the direct sum of all simples in $\mathcal{C}$. Finally, we show that the local topological order axioms give rise to a canonical state on the boundary algebras, and we find that the type of the von Neumann algebra resulting from this construction depends on whether the category $\mathcal{C}$ is pointed. This is joint work with Corey Jones, Pieter Naaijkens, and David Penneys.