ABSTRACTS

Some Advances about the Existence of Compact Involutions in Semisimple Hopf Algebras

ANDRES ABELLA

A compact quantum group is a $*$-Hopf algebra H such that every H-comodule has an H-invariant inner product; this condition implies that H is cosemisimple. When H is finite-dimensional we have then that H is semisimple. Hence there is the natural question if every complex semisimple Hopf algebra is a compact quantum group. This is a very old question from G. I. Kac.

In this talk we will show first that all complex semisimple Hopf algebras of dimension up to 23 are compact quantum groups. Then we consider the general case, showing that it is enough to answer the above question when H is semisimple and quasitriangular. A first approximation to this problem is to consider the case when H is semisimple and triangular. This problem did not seem to be easy, but we can show that under certain additional hypothesis the answer is affirmative.
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Hopf Monoids Relative to a Hyperplane Arrangement

MARCELO AGUIAR

The talk is based on recent and ongoing work with Swapneel Mahajan. We will introduce a notion of Hopf monoid relative to a real hyperplane arrangement. When the latter is the braid arrangement, the notion is closely related to that of a Hopf monoid in Joyal's category of species, and to the classical notion of connected graded Hopf algebra. We are able to extend many concepts and results from the classical theory of connected Hopf algebras to this level. The extended theory connects to the representation theory of a certain finite dimensional algebra, the Tits algebra of the arrangement. This perspective on Hopf theory is novel even when applied to the classical case. We will outline our approach to generalizations of the classical Leray-Samelson, Borel-Hopf, and Cartier-Milnor-Moore theorems to this setting. Background on hyperplane arrangements will be reviewed.
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On Irreducible Representations of Lestrygonian Nichols Algebra

DIRCEU BAGIO

Let $\Bbbk$ an algebraically closed field of characteristic 0, $q \in \Bbbk^\times$ and $\mathscr{G} \in \mathbb{N}$. Consider the algebra $\mathcal{B}$ generated by $x_1, x_2, (z_n)_{0\le n\le\mathscr{G}}$ with defining relations

$$\begin{aligned}
&x_2x_1 - x_1x_2 + \frac{1}{2}x_1^2, && x_1z_0 - q\,z_0x_1, && z_nz_{n+1} - q^{-1}\,z_{n+1}z_n,\\
&x_2z_n - qz_nx_2 - z_{n+1}, && x_2z_{\mathscr{G}} - qz_{\mathscr{G}}x_2, && 0 \le n < \mathscr{G}.
\end{aligned}$$

Actually, $\mathcal{B} = \mathcal{B}(\mathfrak{L}_q(1,\mathscr{G}))$ is the Nichols algebra of the braided vector space $\mathfrak{L}_q(1,\mathscr{G})$ that has a basis $x_1, x_2, x_3 := z_0$, cf. [1, §4.1.1], and it is called Lestrygonian algebra. Also, $\mathcal{B}$ is a domain and $\operatorname{GKdim}\mathcal{B} = 3 + \mathscr{G}$. The quantum plane $\Bbbk_q[X,Y]$ is the algebra generated by X and Y subject to the relation $XY - qYX$, where $q \in \Bbbk$ and $q \neq 1$. The category $\operatorname{Irrep}\Bbbk_q[X,Y]$ of finite-dimensional irreducible representations of $\Bbbk_q[X,Y]$ is well-known. It is shown that $\operatorname{Irrep}\mathcal{B} \simeq \operatorname{Irrep}\Bbbk_q[X,Y]$. This is a work in collaboration with N. Andruskiewitsch, D. Flôres and S. D. Flora.

References

[1] N. Andruskiewitsch, I. Angiono and I. Heckenberger. *On finite GK-dimensional Nichols algebras over abelian groups.* Mem. Amer. Math. Soc., to appear.

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The Character Algebra for Module Categories Over Hopf Algebras

NOELIA BORTOLUSSI

For an aribitrary finite tensor category $\mathcal{C}$, Shimizu introduced the notion of adjoint algebra $\mathcal{A}_{\mathcal{C}}$ and the space of class fuctions $CF(\mathcal{C})$. This concepts generalize the notion of adjoint representation and the character algebra of a finite group. In his work "Futher results on the structure of (co)ends in finite tensor categories" (2018), he defines the adjoint algebra $\mathcal{A}_{\mathcal{M}}$ and the space of class functions $CF(\mathcal{M})$ associated to a module category $\mathcal{M}$ over a finite tensor category. In this talk I will present an explicit computation of the adjoint algebra in the case $\mathcal{C}$ is the representation category of a finite dimensional Hopf algebra H and $\mathcal{M}$ is an exact indescomposable module category over $\mathrm{Rep}(H)$. We describe the adjoint algebra $\mathcal{A}_{\mathcal{M}}$ as an object in the category of Yetter-Drinfeld modules over H. This talk is based on a joint work with M. Mombelli.
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Automorphism Groups of Projective Varieties

MICHEL BRION

The automorphism group of a projective algebraic variety X is known to be a locally algebraic group, extension of a discrete group by a connected algebraic group. The "discrete part" is quite mysterious; recent examples of Lesieutre and Dinh-Oguiso show that it is not necessarily finitely generated. The talk will consider the case where X has an action of a connected algebraic group G with an open dense orbit. We will see that the discrete part of $\mathrm{Aut}(X)$ is a finite group when G is linear, and an arithmetic group when G is arbitrary.
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Invariants of 3-Manifolds, TQFTs and Hopf Diagrams

ALAIN BRUGUIERES

I will recall how it is possible to construct 3-manifold scalar invariants using tensor categories with a ribbon structure and a coend. The coend is a God-given Hopf algebra sitting inside the category, enjoying a certain universal property and carrying additional algebraic structures which reflect much of the structure of the ambient category.

I will also explain how this scalar invariant extends to a TQFT (that is, a functor), based on Mickaël Lalouche's PhD thesis. Lastly, I will discuss how, using the notion of Hopf diagrams introduced in a previous joint work with A. Virezlizier, the coend could be replaced with any Hopf algebra endowed with suitable additional structure.
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Quasi-Compact Group Schemes and Their Representations

PEDRO LUIS DEL ÁNGEL RODRÍGUEZ

We develop a representation theory for extensions of an abelian variety by an affine group scheme. We characterize the categories that arise as such a representation theory, generalizing in this way the classical theory of Tannaka Duality established for affine group schemes.
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On Invariants of Modular Categories Beyond Modular Data

CESAR GALINDO

We introduce new invariants of modular categories that are beyond the modular data, with an eye towards a simple set of complete invariants for modular categories. Our focus is on the W-matrix –the quantum invariant of a colored framed Whitehead link from the associated TQFT of a modular category. We prove that the W-matrix and the set of punctured S-matrices are strictly beyond the modular data (S, T). Whether or not the triple (S, T, W) constitutes a complete invariant of modular categories remains an open question. The talk is based on joint work with Parsa Bonderson, Colleen Delaney, Eric C. Rowell, Alan Tran, and Zhenghan Wang.
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Generalized KLR Algebras and Mutation

AGUSTIN GARCIA IGLESIAS

Khovanov-Lauda [KL] and Rouquier [R] independently constructed a graded additive monoidal category which categorifies certain quantum groups. The so-called *KLR algebras* are some morphism algebras in this category. As an example, the endomorphism algebra $\mathrm{End}(E_i^k)$, associated to a *simple root object* E_i, is the famous nilHecke algebra.

In this talk we shall review this ideas and introduce twisted derivation algebras, built upon generalizations of the nilHecke algebra, and a mutation process which takes two such algebras and a linking polynomial Q, and produces a third twisted derivation algebra, corresponding to the commutator of two given roots. This is a step in the process of defining generalized KLR algebras, to categorify more general root vectors.

This is a work in progress, joint with Ben Elias (U. of Oregon, USA).

REFERENCES

[KL] M. KHOVANOV, A. LAUDA. *A diagrammatic approach to categorification of quantum groups I.* Representation Theory **13** (2009).

[R] R. ROUQUIER, *2-kac-moody algebras.* arXiv:0812.5023 (2008).

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Continuous Fractions, Applications and Generalizations

GERARDO GONZALEZ SPRINBERG

Introduction to continuous fractions for rational and irrationals, applications to surface singularities and generalization to dimension 3 for cubic irrationtals.
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Homological Properties of Restricted Lie álgebras

ADRIANA JUZGA LEON

Lie algebras over fields of characteristic $p > 0$ often have an additional structure involving a special class of applications of given algebra in itself. Such structure was first studied by Jacobson in and called by him restricted Lie algebras.

The main objective of our research is to determine a criterion to study when a restricted metabelian Lie algebra is finitely presented. Using the results obtained by Bryant and Groves for the case of the metabelian Lie algebra and some homology techniques defined now in the context of restricted Lie algebras give answer to our problem in the especific that the Lie

algebra is defined over a perfect fiel of positive characteristica. Some additional homological properties are studied too in this context.
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Commutatively Closed Sets

André Leroy

In this talk a subset S of a ring R will be called commutatively closed if for any $x, y \in R$ such that $xy \in S$ we also have $yx \in S$. We will present many examples of this situation and describe constructions of these subsets. Connexions with different kind of rings will be given.
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Implicative Algebras: Unifying Forcing and Realizability

Alexandre Miquel

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A Robuster Scott Rank

Antonio Montalbán

The Scott rank was introduced in the 60's as measure of complexity for algebraic structures. There are various other ways to measure the complexity of structures that give ordinals that are close to each other, but are not necessarily equal. We will introduce a new definition of Scott rank where all these different ways of measuring complexity always match, obtaining what the author believes it the correct definition of Scott Rank. We won't assume any background in logic, and the talk will consist mostly of an introduction to these topics.
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Extension of Tensor Categories By Finite Group Fusion Categories

Sonia Natale

We study exact sequences of finite tensor categories of the form $\mathrm{Rep}G \to \mathcal{C} \to \mathcal{D}$, where G is a finite group. We show that, under suitable assumptions, there exists a group Γ and mutual actions by permutations $\triangleright\colon \Gamma \times G \to G$ and $\triangleleft\colon \Gamma \times G \to \Gamma$ that make (G, Γ) into matched pair of groups endowed with a natural crossed action on $\mathcal{D}$ such that $\mathcal{C}$ is equivalent to a certain associated crossed extension of $\mathcal{D}$. Dually, we show that an exact sequence of finite tensor categories $\mathrm{vect}_G \to \mathcal{C} \to \mathcal{D}$ induces an $\mathrm{Aut}(G)$-grading on $\mathcal{C}$ whose neutral homogeneous component is a $(Z(G), \Gamma)$-crossed extension of a tensor subcategory of $\mathcal{D}$. As an application we prove that such extensions $\mathcal{C}$ of $\mathcal{D}$ are weakly group-theoretical fusion categories if and only if $\mathcal{D}$ is a weakly group-theoretical fusion category. In particular, we conclude that every semisolvable semisimple Hopf algebra is weakly group-theoretical.
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On Abelian Extensions

Antonio Paques

By an abelian extension we mean a Galois extension whose Galois group is abelian. Tensor product and subalgebra of invariants of abelian extensions are also abelian ones. These facts allow to define an associative, commutative and unital operation on the set of all isomorphism classes of abelian extensions of a fixed commutative ring with the same fixed Galois group . In the case of global actions this set endowed with this operation is a group. However, in

the case of partial actions it has an structure of an inverse semigroup. Such a group (resp., inverse semigroup) is a fundamental tool to classify abelian extensions. In this talk we will deal with partial abelian extensions and present the construction of the corresponding inverse semigroup.
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Purity, Flatness and Finiteness

MARCO ANTONIO PEREZ

The purpose of this talk is to compare two different approaches of pure exact sequences and flat objects in a Grothendieck category with a symmetric monoidal structure. Given a Grothendieck category $\mathcal{G}$, a short exact sequence ε is called fp-pure if the induced sequence of abelian groups $\mathrm{Hom}(F, \varepsilon)$ is exact for every finitely presented object F in $\mathcal{G}$. With this notion of purity, an object C in $\mathcal{G}$ is fp-flat if every epimorphism onto C is fp-pure. In the case where $\mathcal{G}$ is equipped with a symmetric monoidal structure given by a tensor product $\otimes$, we can consider alternative notions of purity and flatness. Namely, ε is $\otimes$-pure if $N \otimes \varepsilon$ is an exact sequence in $\mathcal{G}$ for every N. Moreover, an object C in $\mathcal{G}$ is $\otimes$-flat if the functor $(C \otimes -)$ is exact. These two concepts for purity and flatness are not necessarily equivalent. We shall present properties for each of them and compare some results obtained within these two approaches. This involves the construction of some cotorsion pairs, minimal right approximations, and model category structures. If time allows, we shall also study flat objects relative to objects of type FPn for n ¿ 1 (a generalisation for finitely presented objects). - This is a joint work with Daniel Bravo, Sergio Estrada, James Gillespie and Alina Iacob. -
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Primitive Elements in Generalized Bialgebras

MARIA RONCO

Unital infinitesimal bialgebras appear as natural when when we consider the free associative algebra $\mathrm{As}(V)$ spanned by a vector space V. Fixing a basis, the dual coproduct is coassociative, and both structures determine a unital infinitesimal bialgebra on $\mathrm{As}(V)$. This bialgebra is completely determined by the subspace of its primitive elements, and there exists a canonical projection into this subspace which completely determines the bialgebra.

In fact, when a unital associative algebra A is equipped with a character ϵ (i.e. an algebra homomorphism from A to the base field $\mathcal{K}$, there exists a product $*_\epsilon$ defined on $A \otimes A$ such that a unital bialgebra on A is just a coassociative coproduct $\Delta\colon A \longrightarrow A \otimes A$, satisfying that Δ is an algebra homomorphism for $*_\epsilon$.

When a unital infinitesimal bialgebra A has some additional structure, the subspace of primitive elements inherits somo algebraic structure. We are going to describe some examples of unital infinitesimal bialgebras, with structure theorems which describe them completely:

(1) The Hopf algebra of standard Young tableaux, introduced by C. Poirier and C. Reutenauer,
(2) the Hopf algebra of finite posets, defined by V. Pilaud and V. Pons,
(3) the free 2-associative bialgebras,

the first two examples are a joint work with D. Arlestein, C. Benedetti, A. Gónzalez, R. Gónzalez, J. Gutiérrez, D. Tamayo and Y. Vargas), the third one is a joint work with I. Gálvez-C. and A. Tonks.

The second part of the talk is to explain how we may change the usual tensor product by a monomial structure in the category of paths over a graph (which is neither symmetric, nor distributive), and still apply our structures theorems to get idempotents projection into cycles in this context.

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Examples of Finite Dimensional Hopf Algebras Over Non-Abelian Groups

GUILLERMO SANMARCO

We will recall some results of Heckenberger and Vendramin regarding the classification of finite dimensional Nichols algebras of pairs of absolutely simple Yetter-Drinfeld modules over non-abelian groups. Then we will focus on one particular example of such pairs. We present the corresponding Nichols algebras by generators and relations and compute all the liftings.
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Tame and Wild Automorphisms of Free Algebras

IVAN SHESTAKOV

An automorphism ϕ of a free algebra $F_{\mathcal{V}}[x_1, \dots, x_n]$ from a class $\mathcal{V}$ is called *elementary* if it is of the form

$$\phi\colon (x_1, \dots, x_n) \mapsto (x_1, \dots, \lambda x_i + f, \dots, x_n)$$

where $0 \neq \lambda \in F$ and the element f belongs to the subalgebra generated by $x_1, \dots, x_{i-1}, x_{i+1}, \dots x_n$.

An automorphism is called *tame* if it can be represented as a composition of elementary automorphisms, otherwise it is called *wild*.

It is known that the automorphisms of polynomial algebra and of free associative algebra are tame in case of two generators while in case of three generators there exist wild automorphisms. In our talk, we will discuss known results and open problems on tame and wild automorphisms in various classes of algebras.
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TBA

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Galois Connections for Incidence Hopf Algebras of Combinatorial Partially Ordered Sets

YANNIC VARGAS

Almost 20 years ago, Walter Ferrer and Marcelo Aguiar wrote the paper "Galois connections for incidence Hopf algebras of partially ordered sets". We will show how several nice results of this work can be applied to get results in two (old and new) combinatorial Hopf algebras: the Hopf algebra of permutations of Malvenuto and Reutenauer (1995), and the Hopf algebra of integer binary relations of Pilaud and Pons (2018).
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Minimal Modular Extensions for Super-Tannakian Categories

CESAR FERNANDO VENEGAS RAMIREZ

The purpose of this talk is to give a first approximation for the classification of minimal modular extensions of super-tannakian fusion categories using the concept of fermionic fusion categories, equivariantization and de-equivariantization. In the case of a Tannakian fusion category, the problem has a solution in terms of group cohomology, leaving the super-tannakian case as an open problem.

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