WORKSHOP 'GEOMETRY AND REPRESENTATION THEORY'
PARIS, JAN. 27TH-31ST, 2020

Noriyuki ABE (University of Tokyo): On Soergel bimodules

Soergel introduced the category which is now called the Soergel bimodules and showed that the category gives a categorification of the Hecke algebra. His theory works well over characteristic-0 fields but not so well over positive characteristic fields. I will explain how to modify his theory to work in more general situations. I will also compare the modified category with other categorifications of the Hecke algebra

Pramod ACHAR (Louisiana State University): Around the Humphreys conjecture

Let G be a reductive algebraic group over a field of characteristic $p > h$. The "G_1-cohomology construction" associates to any G-module M a certain coherent sheaf on the nilpotent variety of G. This construction seems to be especially rich when M is a tilting module. The Humphreys conjecture (now a theorem if p is large, or if G is of type $\mathbf{A}$) predicts the support of this coherent sheaf; more recent conjectures propose finer descriptions of the coherent sheaves arising in this way. I will explain these conjectures and their connections to other topics (e.g., tensor ideals of tilting modules), with a special focus on the case of GL_n. This talk is based on joint work with W. Hardesty and S. Riche.

Tomoyuki ARAKAWA (Research Institute for Mathematical Sciences, Kyoto University): Coset construction of W-algebras and applications

First, I will report on the joint work with Thomas Creutzig and Andrew R. Linshaw on the coset construction of W-algebras. Then I will explain how it is used in the recent work of Nakajima and Muthiah on a reformulation of the AGT conjecture in view of affine geometric Satake and Coulomb branches. Finally, I will talk about a closely related result with Edward Frenkel on the quantum geometric Langlands correspondence.

Pierre BAUMANN (Centre National de la Recherche Scientifique & Université de Strasbourg): Equivariant multiplicities of Mirković–Vilonen cycles and Weyl group action

In 1984 Joseph assigned to any orbital variety a 'characteristic polynomial' on the Cartan algebra, related to the equivariant cohomology class of the associated cone bundle over the flag variety. This map intertwines Springer's representation with the action of the Weyl group on polynomials. Last year, Muthiah suggested that the equivariant cohomology of Mirković–Vilonen cycles could bear a similar relation with the action of the Weyl group on the zero weight subspace of a representation. We will argue that this result holds true. Joint work with Joel Kamnitzer and Allen Knutson.

Jonathan BRUNDAN (University of Oregon): Heisenberg and Kac–Moody categorification

I will talk about recent joint work with Alistair Savage and Ben Webster in which we establish a direct relationship between Heisenberg categorical actions and Kac–Moody categorical actions. This gives a rather direct way to prove the existence of an action of the Kac–Moody 2-category on several fundamental Abelian categories appearing in representation theory, including representations of symmetric groups, general linear groups, cyclotomic Hecke algebras, rational Cherednik algebras and cyclotomic q-Schur algebras.

Ivan CHEREDNIK (University of North Carolina at Chapel Hill): DAHA superpolynomials

The DAHA superpolynomials are invariants of colored iterated torus links, generalizing the HOMFLY-PT polynomials. Presumably they can be defined for all 5 Deligne–Vogel series, but this is fully done only for type A beyond some particular knots. In the uncolored case and for iterated knots, they are conjectured to coincide with the stable reduced Khovanov–Rozansky polynomials, the most powerful numerical knot invariants we have. For uncolored torus knots, this is due to Elias, Hogancamp and Mellit. Also, DAHA superpolynomials conjecturally coincide with the motivic superpolynomials of plane curve singularities and satisfy certain Riemann Hypothesis. The latter will be stated in the uncolored case, though we will mostly focus on the DAHA constructions in this talk.

Dan CIUBOTARU (University of Oxford): Elliptic representations of affine Hecke algebras and the nonabelian Fourier transform

There are two nonabelian Fourier transforms related to elliptic unipotent representations of semisimple p-adic groups (and elliptic modules for the corresponding affine Hecke algebras). The elliptic representation theory studies characters modulo the parabolically induced ones. The unipotent category of representations was defined by Lusztig and it can be thought of as being the smallest subcategory of smooth representations that is closed under the formation of L-packets and such that it contains the Iwahori representations. The first Fourier transform is defined on the p-adic group side in terms of the pseudocoefficients of these representations, branching to maximal parahoric subgroups, and Lusztig's nonabelian Fourier transform for characters of finite groups of Lie type. The second one is defined "on the dual side" in terms of the Kazhdan-Lusztig parameters for unipotent elliptic representations of a split p-adic group. I will present a conjectural relation between them, and exemplify this conjecture in some cases that are known, the most notable case being that of special orthogonal groups, by the work of Moeglin and Waldspurger. The talk is based on joint work with Eric Opdam.

Kevin COULEMBIER (University of Sydney): Some homological and combinatorial properties of highest weight categories

We explain scenarios in which a highest weight structure on a category (according to several definitions appearing in the literature) is 'unique.' We also obtain some auxiliary results about the homological connection between an abelian category and its ind-completion. As an application we present a complete classification of the equivalences between categories that appear as blocks in BGG category $\mathscr{O}$ for all reductive Lie algebras.

Michael FINKELBERG (National Research University Higher School of Economics): Satake equivalence for classical supergroups

We prove a particular case of a degenerate version of Gaiotto's conjectures, relating equivariant perverse sheaves on the affine Grassmannian of a special orthogonal group to representations of an orthosymplectic Lie superalgebra. This is also a particular case of the Periods – L-functions duality conjectures of Ben-Zvi, Sakellaridis and Venkatesh. It is a work of R. Travkin, V. Ginzburg and A. Braverman.

Amit HAZI (City University): Ringel duality for Soergel bimodules

The category of Soergel bimodules is a well-behaved categorification of the Hecke algebra of a Coxeter group. In many characteristic-0 realizations, the indecomposable objects in this category correspond to the Kazhdan–Lusztig basis, thereby giving an explanation for the positivity of Kazhdan–Lusztig polynomials. In characteristic $p > 0$ the indecomposable objects give rise to another set of non-negative Laurent polynomials called p-Kazhdan–Lusztig polynomials, which can be used as a replacement for Kazhdan–Lusztig polynomials in modular representation theory. In this talk I will introduce a non-negative potential replacement for inverse Kazhdan–Lusztig polynomials in positive characteristic.

Rinat KEDEM (University of Illinois): Toda Hamiltonians for the quantum Q-system

The quantum Q-systems are discrete non-commutative evolution equations for generators of the spherical nil-DAHA for each root system. It is defined as a deformation of the Grothendieck ring of finite-dimensional affine algebra modules, the natural quantization of the cluster algebra structure. These systems are integrable, with the commuting Hamiltonians being difference Toda hamiltonians acting on "weight spaces." The generators act as raising operators for q-Whittaker functions or their generalizations, which are graded characters of tensor products. I will review recent progress in proving these statements. Joint work with Philippe Di Francesco.

Alexander KLESHCHEV (University of Oregon): RoCK blocks for symmetric groups and Schur algebras

We discuss a description of the RoCK blocks of symmetric groups and Schur algebras in terms of generalized zigzag and extended zigzag Schur algebras, as (partially) conjectured by W. Turner. This can be considered as a "local description" of blocks of symmetric groups and Schur algebras up to derived equivalence.

Ivan LOSEU (Yale University): On equivariantly irreducible modular representations of semisimple Lie algebras

Let G be a semisimple algebraic group over an algebraically closed field $\mathbb{F}$ of very large positive characteristic. We give a combinatorial classification and find Kazhdan–Lusztig type character formulas for modules over the Lie algebra $\mathfrak{g}$ that are equivariantly irreducible with respect to an action of a certain subgroup of G whose connected component is a torus. This is a joint work with Roman Bezrukavnikov.

Shotaro MAKISUMI (Columbia University): The free-monodromic category

Joint work with M. Hogancamp.

Volodymyr MAZORCHUK (Uppsala Universitet): Simple 2-representations of Soergel bimodules

In this talk we report on the progress in the project of classifying simple transitive 2-representations of the 2-category of Soergel bimodules (over the coinvariant algebra over the complex numbers) associated to a finite Weyl (resp. Coxeter) group. Joint work with Marco Mackaay, Vanessa Miemietz, Daniel Tubbenhauer and Xiaoting Zhang.

Peter McNAMARA (University of Melbourne): Braid group actions, KLR algebras and geometry

I will talk about some categorical braid group actions that categorify the braid group action on the quantum group. Algebraic approaches via Richard complexes and geometric approaches via parity sheaves will be discussed.

Anne MOREAU (Université Lille 1): Chiral symplectic leaves and arc spaces

In this talk, I will introduce the notion of chiral symplectic leaves which can be viewed as analogs of symplectic leaves in Poisson vertex varieties. Typical examples of Poisson vertex varieties are the arc spaces of Poisson varieties. I will give various applications to vertex algebras, and particularly to W-algebras. This is based on joint works with Tomoyuki Arakawa.

Emily NORTON (Technische Universität Kaiserslautern): Generalized Mullineux involution and perverse equivalences

The Mullineux involution on p-regular partitions describes the result of tensoring an irreducible representation of the symmetric group with the sign representation in characteristic p. More generally, we may work in the setting of Hecke algebras at an e-th root of unity (e not necessarily prime). An algorithm for computing the Mullineux involution using colored directed graphs was discovered by Kleshchev in 1995. Building on this crystal perspective, we generalize the definition of Mullineux involution to all charged multipartitions. The generalized Mullineux involution arises naturally in representation theory as the combinatorial shadow of certain derived equivalences on module categories. This is joint work with Thomas Gerber and Nicolas Jacon.

Mark SHIMOZONO (Virginia Tech): Wreath Macdonald polynomials

In 2003 Haiman defined wreath Macdonald polynomials in terms of plethystic operations on tensor products of symmetric functions. His construction arose from Nakajima varieties for the cyclic quiver. We will discuss some recent developments, including wreath analogues of Macdonald operators in tensor symmetric function operator form coming from the quantum toroidal algebra, and also of the famous nabla operator. This is based on ongoing joint work with Dan Orr and with Mark Haiman.

Catharina STROPPEL (University of Bonn): From Deligne categories to the representation theory of Lie supergroups

Deligne categories are universal tensor categories which should govern the representation theory of algebraic groups and supergroups. I will explain how this works and apply it explicitly to the case of classical supergroups. As an application this provides decomposition numbers, character formulas and a description of the endomorphism ring of a projective generator for the case of the orthosymplectic groups $\mathrm{OSp}(m|2n)$. On the way we will describe a connection with Kazdhan Lusztig cells and indicate why the super case gives a nicer categorification of certain cells than for instance classical category $\mathscr{O}$.

Ulrich THIEL (Technische Universität Kaiserslautern): Symplectic leaves in Calogero–Moser spaces

Calogero–Moser spaces are Poisson deformations of symplectic quotient singularities. Their geometry encodes many interesting representation-theoretic information, especially in the context of Hecke algebras. Even though not smooth and not symplectic in general, they admit a stratification into smooth symplectic subvarities: their symplectic leaves. I find it is an interesting problem to classify and describe these leaves explicitly. In my talk, I will give an introduction to this problem, explain what I know, and mention some conjectures and open problems. This is joint work with G. Bellamy.