REPRESENTATION THEORY IN SAMOS

4 - 8 July 2016

Schedule

All talks will take place at **Provatari Building** near the port of Karlovassi.

Note that

- Registration will take place at the conference venue on Monday from 9:00 to 9:30.
- All talks on **Wednesday** will start 30 MINUTES EARLIER than the time indicated because of the excursion.
- The conference dinner will take place on Thursday at 20:00 at **Restaurant Azzurro**.

Time	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
09:30–10:20	Broué	Joseph	Kontogeorgis (09:00)	Lübeck	Batakidis
10:30–11:20	Bonnafé	Leclerc	Thévenaz (10:00)	Michel	Lamprou
11:20–11:50	*Coffee Break*	*Coffee Break*	*Excursion*	*Coffee Break*	*Coffee Break*
11:50–12:40	Bowman	Jacon		Maliakas	Gordon
12:40–14:30	*Lunch Break*	*Lunch Break*		*Lunch Break*	
14:30–15:00	Lanini	Gkountaroulis		Stergiopoulou	
15:15–15:45	Saunders	Chavli		Bavula	
16:00–16:30	Norton	Gerber		Bouayad	

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Titles & Abstracts

Panagiotis BATAKIDIS : *Deformation quantization for representation theory.*

In the late 90's M. Kontsevich related his construction of the deformation quantization of a Poisson structure with the Duflo Isomorphism. This observation led to a deformation quantization approach of representation theory questions. Based on this idea, we prove grading properties of deformation quantization when applied on weight homogeneous Poisson structures. As an application, and given a semisimple Lie algebra $\mathfrak{g}$ and a nilpotent element e, these properties enable us to prove a Duflo-type isomorphism between the W-algebra associated to the pair $(\mathfrak{g}, e)$ and a known deformation quantization object, the reduction algebra. We then prove that it is a polynomial algebra and construct explicit generators starting from a basis of the centralizer $\mathfrak{g}_e$. This is joint work with N. Papalexiou.

Vladimir BAVULA : *Classification of simple weight modules over the Schrödinger algebra.*

A classification of simple weight modules over the Schrödinger algebra is given. A typical simple weight module depends on arbitrary large finite number of independent parameters. The Krull and the global dimensions are found for the centralizer $C(H)$ (and some of its prime factor algebras) of the Cartan element H in the universal enveloping algebra S of the Schrödinger (Lie) algebra. The simple $C(H)$-modules are classified. Explicit generators and defining relations are given for the algebra $C(H)$. The Krull and the global dimensions are found for some (prime) factor algebras of the algebra S (over the centre). It is proved that some (prime) factor algebras of S and $C(H)$ are tensor homological/Krull minimal.

Cédric BONNAFÉ : *Categorification of some $\mathbb{Z}$-modular datum.*

To the infinite family of complex reflection groups $G(d, 1, n)$, G. Malle has associated $\mathbb{Z}$-modular data, generalizing those constructed by G. Lusztig for $d = 1$ or 2, in link with the representation theory of finite classical groups. We will describe the $\mathbb{Z}$-modular datum corresponding to the $n = 1$ case, and show how it can be categorified by the stable category of the Drinfeld double of the Taft algebra. This is joint work with Raphaël Rouquier.

Alexandre BOUAYAD : *Deformations of Kac-Moody algebras through Tannaka duality.*

The Tannaka biadjunction is a reflective biadjunction between the category of algebras and the 2-category of categories equipped with a forgetful functor. The Tannaka biadjunction can then be used to study an algebra A within an extended and richer world, by replacing A with the category of A-modules. In this talk, I will apply this idea to Kac-Moody algebras. I will explain how a deformation of the action of the Chevalley generators on the category formed by the integral Verma modules leads naturally to a deformation of the Chevalley-Serre presentation. In the symmetrizable case, I will show that this process yields a one-to-one correspondence between the two moduli spaces of deformations. I will show that we obtain as a consequence a new proof of rigidity results for symmetrizable Kac-Moody algebras, with no cohomological calculations.

Chris BOWMAN : *Kronecker Tableaux.*

The Kronecker problem asks for an algorithmic understanding of the coefficients arising in the decomposition of the tensor product of two simple modules for the symmetric group. We provide an algorithm for calculating Kronecker coefficients labelled by so-called co-Pieri triples of partitions. This, in some sense, solves half of the Kronecker problem. This is joint work with Maud De Visscher and John Enyang.

Michel BROUÉ : *Cyclotomic Root Systems.*

The spirit of the Spetses program is to consider (at least some of) the complex reflections groups as Weyl group for something which looks like a "generic finite reductive group" – and which is yet unknown.

Some of the data attached to finite reductive groups, such as the parametrization of unipotent characters, their generic degrees, Frobenius eigenvalues, and also the families and their Fourier matrices, turn out to depend only on the $\mathbb{Q}$-representation of the Weyl group. But supplementary data, such as the parametrization of unipotent classes, the values of unipotent characters on unipotent elements, depend on the entire root datum.

For a complex reflection group (not necessarily defined over $\mathbb{Q}$, but defined over an abelian number field K), it thus seems both necessary and natural to study "$\mathbb{Z}_K$-root data", where $\mathbb{Z}_K$ denotes the ring of integers of K.

In a joint work with Ruth Corran and Jean Michel, we define and classify $\mathbb{Z}_K$-root systems, root lattices and coroot lattices, for all complex reflection groups. A surprising fact comes out : in the case of spetsial reflection groups, the order of the group is divisible by the factorial of the rank times the *connection index*, and the bad primes for the corresponding Spets make up the remainder, just as in the case of finite reductive groups and Weyl groups.

Eirini CHAVLI : *The irreducible representations of B_3 of small dimension.*

In 1999 I. Tuba and H. Wenzl classified the irreducible representations of the usual braid group on 3 strands of dimension k at most 5, by giving explicit matrices of a triangular form whose coefficients are completely determined by the eigenvalues and a k-th root of their determinant. Moreover, they proved that such irreducible representations exist if and only if the eigenvalues do not annihilate some polynomials in the eigenvalues and this root of the determinant. In this talk we will explain the reason we have matrices in this neat form, as well as, the origin of the above polynomials by recovering this classification as a consequence of the freeness conjecture for the generic Hecke algebra associated to the finite quotients of B_3.

Thomas GERBER : *Triple crystal structure for Fock spaces.*

Combinatorial Fock spaces play a key role in the modular representation theory of complex reflection groups (and related structures) and finite classical groups. They have a triple module structure: for two quantum groups of affine type A, and for a Heisenberg algebra. The Kashiwara crystal arising from a quantum group action is known to have several important interpretations. I will explain how to define a suitable notion of crystal for the Heisenberg algebra, intertwining the two Kashiwara crystals. This gives new results about the representation theory of finite unitary groups and rational Cherednik algebras.

Dimoklis GKOUNTAROULIS : *A new 2-variable generalization of the Jones polynomial.*

Since the original construction of the Jones polynomial, the Temperley-Lieb algebra has become a cornerstone of a fruitful interaction between Knot theory and Representation theory. The Temperley-Lieb algebra was introduced by N. Temperley and E. Lieb in a statistical mechanical context in 1971 and was rediscovered by V.F.R. Jones as a knot algebra in 1983. A knot algebra comprises an algebra A, an appropriate representation of the braid group in A and a Markov trace function defined on A. The Temperley-Lieb algebra, the Iwahori-Hecke algebra and the BMW algebra are the most known examples of knot algebras. In this talk we will present a new 2-variable generalization θ of the Jones polynomial that is derived from the framization of the Temperley-Lieb algebra. The framization of a knot algebra is a relatively new technique that was proposed by J. Juyumaya and S. Lambropoulou and it consists in an extension of a knot algebra via the addition of framing generators which are intrinsically involved in the algebra relations. In this way one obtains a new algebra which is related to framed braids and framed knots. The basic example of framization is the Yokonuma-Hecke algebra which can be regarded as a framization of the Iwahori-Hecke algebra. We will prove the well-definedness of the new invariant θ both algebraically and skein theoretically. The 2-variable invariant θ coincides with the Jones polynomial on knots but is stronger than the Jones polynomial in links, as it can detect more pairs of non-isotopic links.

Iain GORDON : *Parking spaces, after Armstrong, Reiner and Rhoades.*

This is joint work in progress with Martina Lanini. I will review a recent conjecture of Armstrong, Reiner and Rhoades that gives more structure to known bijections between (various complex reflection group generalisations of) non-crossing partitions and non-nesting partitions using the representation theory of rational Cherednik algebras. I will explain how this conjecture may be related to the so-called LL morphism and give some evidence currently. There's much to do and help would be welcome!

Nicolas JACON : *On the structure of the Yokonuma–Hecke algebras and applications.*

The Yokonuma–Hecke algebras have been defined in the 1960s in the context of Chevalley groups, as generalizations of Iwahori–Hecke algebras. They can also be defined as deformations of complex reflection groups. Recently they have been used to obtain new invariants for classical knots and links. We here review several results around these algebras and explain their links with the Iwahori–Hecke algebras. We in particular give a classification of all the Markov traces on them. This is a joint work with Loïc Poulain d'Andecy.

Anthony JOSEPH : *S-Graphs.*

S-graphs were introduced to exhibit the structure of the Kashiwara $B(\infty)$ crystal. The latter is of some importance as it encapsules the representation theory of integrable highest weight modules for Kac-Moody Lie algebras. S-graphs have some remarkable properties which will be described as well as how they can be expected to determine $B(\infty)$. Part of this work was done in collaboration with Polyxeni Lamprou and Shmuel Zelikson.

Aristides KONTOGEORGIS : *Applications of representation theory to the deformation theory of curves.*

We will describe the problem of Galois module structure of global sections on holomorphic differentials on curves within the theory of integral representations and its relation to the deformation theory of curves and the lifting problem from characteristic zero to characteristic p.

Polyxeni LAMPROU : *Polynomiality of symmetric invariants for truncated parabolic subalgebras of semisimple Lie algebras.*

This is joint work with F. Millet. Let $\mathfrak{g}$ be a semisimple algebra and $Y(\mathfrak{g})$ its Poisson centre. It is well-known that $Y(\mathfrak{g})$ is a polynomial algebra. The Poisson centre of subalgebras $\mathfrak{a}$ of $\mathfrak{g}$ has been studied in several cases, in particular when $\mathfrak{a}$ is a centralizer of a nilpotent element (Panyushev-Premet-Yakimova) or a truncated parabolic subalgebra (Joseph-Millet). For these subalgebras it very often happens that $Y(\mathfrak{a})$ is polynomial.

We consider the case where $\mathfrak{a}$ is a truncation of a maximal parabolic subalgebra of $\mathfrak{g}$ and show that $Y(\mathfrak{a})$ is polynomial in the cases where the Joseph-Millet criterion does not apply. The central ingredient of our method is the construction of an *adapted pair*. Adapted pairs were invented in order to construct slices for the coadjoint action of $\mathfrak{a}$, thus generalizing the Slice Theorem due to Kostant. It turns out that they are even more interesting as they may prove (or disprove!) polynomiality of $Y(\mathfrak{a})$.

Martina LANINI : *Degenerate flags and Schubert varieties.*

Introduced in 2010 by Evgeny Feigin, degenerate flag varieties are degenerations of flag manifolds, naturally arising from a representation theoretic context. In this talk, I will discuss joint work with G. Cerulli Irelli, and G. Cerulli Irelli and P. Littelmann, in which we show that such degenerations in type A and C not only share a lot of properties with Schubert varieties (as previously proven by Feigin, Finkelberg and Littelmann), but are in fact Schubert varieties in an appropriate flag manifold.

Bernard LECLERC : *Cluster structure for representations of Borel subalgebras of quantum affine algebras.*

Let $\mathcal{O}$ be the category of representations of the Borel subalgebra of a quantum affine algebra introduced by Jimbo and Hernandez. We show that the Grothendieck ring of a certain monoidal subcategory of $\mathcal{O}$ has the structure of a cluster algebra of infinite rank, with an initial seed consisting of prefundamental representations. In particular, the celebrated Baxter relations for the 6-vertex model get interpreted as Fomin-Zelevinsky mutation relations. This is a joint work with David Hernandez.

Frank LÜBECK : *A recursion formula for some character values of classical groups and some applications.*

Lusztig gave a parameterization of unipotent characters of classical groups by so called symbols. Maximal tori of these groups are parameterized by pairs of partitions. We give a Murnaghan-Nakayama style recursion formula for computing the value of a unipotent character given by its symbol on the regular semisimple conjugacy classes in a type of tori given by a pair of partitions. This relies on deep results by Asai. Using this formula and some technical propositions we derive a result on zeroes of irreducible characters of classical groups. In one application we find a classification of l-modular simple endotrivial modules of classical groups. This talk is about joint work with Gunter Malle.

Michael MALIAKAS : *Resolving representations of* $\mathrm{Gl}(n)$

In this talk we will survey certain aspects of the role of Weyl and projective representations in the integral and modular representation theory of the general linear group. In particular the Weyl filtration dimension of certain Schur algebras will be examined.

Jean MICHEL : *The Sylow subgroups of a finite reductive group.*

This is joint work with Michel Enguehard. We describe the structure of Sylow ℓ-subgroups of a finite reductive group $\mathbf{G}(\mathbb{F}_q)$ when $q \not\equiv 0 \pmod{\ell}$, that we find governed by a complex reflection group $W_{\mathbf{G},\ell}$, which depends on ℓ only through the set of cyclotomic factors of the generic order of $\mathbf{G}(\mathbb{F}_q)$ whose value at q is divisible by ℓ. The Sylow ℓ-subgroups are abelian if and only if $W_{\mathbf{G},\ell}$ is of order prime to ℓ.

This generalizes work of Broué and Malle (1991) for abelian Sylow subgroups, and is related to work of Broto, Grodal, Oliver on ℓ-compact spaces where they find that the ℓ-fusion category of $\mathbf{G}(\mathbb{F}_q)$ is related to $W_{\mathbf{G},\ell}$. Some of these results where obtained case-by-case by Enguehard in 1992, while the current proof is general.

Emily NORTON : *BGG resolutions for rational Cherednik algebras*

The existence of closed character formulas for certain simple modules in Category $\mathcal{O}$ of a Cherednik algebra motivated us to look for resolutions of these simple modules by standard modules ("BGG resolutions"). We prove a general criterion for when every simple module in a block of a highest weight category has a BGG resolution. Then we identify a class of examples satisfying our criterion in the Categories $\mathcal{O}$ of rational Cherednik algebras of cyclotomic type. This is joint work with Stephen Griffeth.

Neil SAUNDERS : *Towards an Exotic Robinson-Schensted Correspondence.*

We consider the Exotic Nilpotent Cone of Kato, which provides a Springer Correspondence between nilpotent orbits of the symplectic group on this nullcone and irreducible representations of the Weyl Group of Type C. By studying the Springer resolution of the Exotic Nilpotent Cone, we are able to demonstrate a bijection between Irreducible Components of the fibres of this resolution and Standard Bitableaux. I will report on recent work with Nandakumar and Rosso where we are using this bijection to explicit determine an "Exotic Robinson-Schensted Correspondence".

Dionysia STERGIOPOULOU : *On extensions of hook Weyl modules.*

In this talk we will discuss our results on the computation of integral extension groups between hook Weyl modules for the general linear group. Using computations with weight spaces, long exact sequences in cohomology and a result of Kulkarni, we study Ext^1, Ext^2 and the highest possible non vanishing Ext. From this, the dimensions of certain modular Ext groups are obtained. Joint work with M. Maliakas.

Jacques THÉVENAZ : *Linear representations of finite sets.*

A correspondence between two finite sets X and Y is a subset of $X \times Y$. One can easily define the composition of correspondences and obtain a category. A correspondence functor is a functor from the category of finite sets and correspondences to the category of k-vector spaces, where k is a field. We are interested in describing the simple correspondence functors. They are parametrized by triples (E, R, V), where E is a finite set, R is an order relation on E, and V is a simple module for the group algebra $k\mathrm{Aut}(R)$. The problem of describing the simple correspondence functor S parametrized by (E, R, V) is not easy, but a formula is obtained for the dimension of each evaluation $S(X)$. The talk will provide an introduction to the subject and a description of various structural results on correspondence functors. This is a joint work with Serge Bouc.