ABSTRACTS OF TALKS

A. Alldridge *Superbosonization, lowest weight modules, and Riesz superdistributions*

Abstract. The superbosonization identity of Littelmann-Sommers-Zirnbauer (LSZ) is an Berezinian integral identity useful in studying the large N asymptotics of the flat Berezin integral over $C^{N\times p|q}$. We show that one side of the LSZ identity is a highest weight functional on a particular lowest weight module of $\mathfrak{gl}(2p|2q)$, with weight depending on N. This provides a new representation theoretic proof of the LSZ identity, and, as a spin-off, a realization of the lowest weight module. Moreover, for $q = 0$, the functional coincides with one of the classical Riesz distributions for the cone of positive definite Hermitian $p \times p$ matrices.

This work is joint with our postdoc Zain Shaikh.

J.Brundan *Whittaker coinvariants for* $gl(m|n)$

Abstract. I'll describe some recent results (joint with J. Brown and S. Goodwin) describing the W-algebra associated to the principal nilpotent orbit in $gl(m|n)$ by some explicit generators and relations. Then I'll discuss properties of the associated Whittaker coinvariants functor, which is a quotient functor from category $\mathcal{O}$ to a certain subcategory of the category of finite dimensional representations of this W-algebra. These results are the first steps in a project which aims to prove a $gl(m|n)$-analogue of Soergel's Endomorphismensatz for semisimple Lie algebras.

N. Cantarini *On* $N = 6$ *3-algebras*

Abstract. $N \leq 8$ 3-algebras have recently appeared in N-supersymmetric 3-dimensional Chern-Simons gauge theories. In this talk we will describe the classification of linearly compact simple N=6 3-algebras over the complex numbers, using their correspondence with simple linearly compact Lie superalgebras with a consistent short Z-grading, endowed with a graded conjugation. We shall also introduce two different definitions of N=6 3-algebras and discuss some differences between them.

K. Coulembier *BGG resolutions for basic classical Lie superalgebras*

Abstract. We study Kostant cohomology and Bernstein-Gelfand-Gelfand resolutions for basic classical Lie superalgebras. For each choice of parabolic subalgebra and irreducible representation, there is a natural definition of the derivative and coderivative, extending the definition of the operators studied by Kostant for Lie algebras. We prove that whenever these two operators are disjoint, there exists a corresponding BGG resolution in terms of the (co)homology groups. For these cases the cohomology groups can be described in terms of the quadratic Casimir operator as in the classical case. Then we use these results to derive explicit criteria under which BGG resolutions exist, which are particularly useful for the superalgebras of type I. For the unitarizable representations of gl(m—n) and $osp(2|2n)$ we derive conditions on the parabolic subalgebra under which the BGG resolutions exist. This extends the BGG resolutions for gl(m—n) previously obtained through superduality and leads to entirely new results for $osp(2|2n)$. We also apply the obtained theory to construct specific examples of BGG resolutions for $osp(m|2n)$ motivated by the study of the algebra of higher symmetries of the super Laplace operator and a Joseph ideal for $osp(m|2n)$.

A. D'Andrea *Noetherianity and vertex operator algebras.*

Abstract. Let V be a vertex operator algebra, and G a reductive group acting on V by graded automorphism. When V is finitely generated, it has been verified in some scattered examples that the fixed point subalgebra V^G is also finitely generated.

On the other hand, it has long been known that (differentially) finitely generated differential algebras may fail to be noetherian, and it is easy to construct examples of finitely generated differential algebras whose fixed point subalgebra, with respect to a finite group of automorphisms, is not finitely generated. This is annoying, as every differential commutative algebra is a vertex algebra in a trivial way. The vertex algebra version of Hilbert's theorem must therefore essentially depend on noncommutative quantum features.

In this talk, I will show that, under some mild noncommutativity assumptions, ideals in a vertex algebra satisfy the ascending chain condition. I will also comment on the relation between this algebraic fact and possible strategies towards proving Hilbert's theorem for vertex algebras.

S.-J. Cheng *Irreducible characters of the general linear Lie superalgebra*

Abstract. Brundan in 2003 formulated a Kazhdan-Lusztig type conjecture for the characters of the irreducible and tilting modules in the BGG category for the general linear Lie superalgebra. In this talk, we shall explain a proof for this conjecture and its variants. This is a joint work with Ngau Lam and Weiqiang Wang.

A. De Sole *Local and non-local Poisson Vertex algebras and applications to the theory of integrable systems*

F. Gavarini *From simple Lie superalgebras to algebraic supergroups*

Abstract. For any finite dimensional (complex) simple Lie superalgebra I present an explicit recipe to construct an algebraic supergroup G (in terms of its functor of points) whose tangent Lie superalgebra is the given $\mathfrak{g}$. This goes through a generalisation of the Chevalley's method, which constructs a (semi)simple algebraic group starting from any complex, f. d. (semi)simple Lie algebra g and a faithful f. d. g-module V.

The key tools to make use of will be suitable integral forms - of $\mathfrak{g}$, $U(\mathfrak{g})$ and V- defined out of the notion of "Chevalley basis" for $\mathfrak{g}$. I shall show that this method can be succesfully adapted when g is replaced with a simple Lie SUPERalgebra, starting from a convenient notion of "Chevalley basis". Quite remarkably, this strategy works both for (simple) Lie superalgebras of classical type and of Cartan type - somehow extending the range of application of Chevalley's original idea.

Besides this existence result, I shall prove uniqueness: every connected algebraic supergroup whose Lie superalgebra be (f.d.) simple is isomorphic to one of the supergroups constructed via the Chevalley procedure. This eventually yields a complete classification of such supergroups.

D. Grantcharov *Queer Lie Superalgebras*

Abstract. The Lie superalgebra $q(n)$ is the second super-analogue of the general Lie algebra gl(n). Due to its complicated structure, $q(n)$ is usually called the queer superalgebra. In this talk we will discuss certain old and new results related to the representation theory and crystal bases of $q(n)$.

C. Hoyt *Good gradings of basic Lie superalgebras*

Abstract. Good $\mathbb{Z}$-gradings of finite-dimensional simple Lie algebras were classified by V.G. Kac and A.G. Elashvili in 2004. This problem arose in connection to W-algebras. We will discuss the proof of the classification of good $\mathbb{Z}$-gradings for the basic Lie superalgebras. We will show that all good $\mathbb{Z}$-gradings of the exceptional Lie superalgebras: $F(4)$, $G(3)$,and $D(2,1,\alpha)$ are Dynkin gradings. The good $\mathbb{Z}$-gradings of $\mathfrak{sl}(m|n) : m \neq n$, $\mathfrak{psl}(n|n)$ and $\mathfrak{osp}(m|2n)$ are classified using certain combinatorial objects called "pyramids", analogously to the Lie algebra setting.

V. Kac *Affine algebras and theta functions vs affine superalgebras and mock theta functions (joint work with Minoru Wakimoto).*

Abstract. I'll describe the main conjectures about partially integrable and admissible modules over affine superalgebras and explain what are theta and mock theta functions. Also, I'll remind the modular invariance for affine algebras and their quantum Hamiltonian reductions. This should serve as a basis for M. Wakimoto's talk on modular invariance for affine Lie superalgebras and their quantum Hamiltonian reductions.

V. Mazorchuk *Koszul duality between generalized Takiff Lie algebras and superalgebras.*

Abstract. In this talk we plan to describe how Lie superalgebras appear as Koszul duals for Lie algebras. We will first review the general setup of Koszul duality for positively graded categories and its generalization to non-negatively graded catgeories. Then we will show how this applies to generalized Takiff Lie algebras and the corresponding superalgebras. This is a report on a joint work with Jacob Greenstein.

P. Möseneder Frajria *Conformal embeddings and simple current extensions*

Abstract. We investigate the structure of intermediate vertex algebras associated with a maximal conformal embedding of a reductive Lie algebra in a semisimple Lie algebra of classical type. Joint work with V. Kac, P. Papi and F. Xu.

I. Musson *Coefficients of Šapovalov elements for simple Lie algebras and contragredient Lie superalgebras*

Abstract. It is well known that non-zero maps between Verma modules for $\mathfrak{g}$ can be described in terms of Šapovalov elements. We provide estimates of the degrees of the coefficients of Šapovalov elements for a simple complex Lie algebra. It is well known that non-zero maps between Verma modules for can be described in terms of such elements. Now let $\mathfrak{g}$ be a contragredient Lie superalgebra such that the set of simple roots contains at most one isotropic root, Let $M(\lambda)$ be a Verma module for a basic classical simple Lie superalgebra $\mathfrak{g} \neq G(3)$ defined using the distinguished Borel subalgebra, and let γ be an isotropic positive root of $\mathfrak{g}$. The existence and uniqueness of the Šapovalov element for γ can be deduced from the corresponding result for simple Lie algebras. For type A Lie superalgebras we give a closed formula for Šapovalov elements.

The uniqueness of the Šapovalov elements is useful when comparing Šapovalov elements coming from different isotropic roots. Often the coefficients of Šapovalov elements are products of linear factors, and we provide some reasons for this coming from representation theory.

E. Poletaeva *On finite W-algebras for Lie superalgebras in the regular case*

Abstract. The finite W-algebras are certain associative algebras associated to a complex semisimple Lie algebra $\mathfrak{g}$ and a nilpotent element e of $\mathfrak{g}$. Due to recent results of I. Losev, A. Premet and others, W-algebras play a very important role in description of primitive ideals. It is a result of B. Kostant that for a regular nilpotent element e, the finite W-algebra coincides with the center of $U(\mathfrak{g})$.

We adopt A. Premet's definition of finite W-algebra W_e for simple Lie superalgebras, and study the case when e is an even regular nilpotent element. Kostant's result does not hold in this case.

We obtain the precise description of finite W-algebras for regular e for classical Lie superalgebras of Type I and defect one, $Q(n)$ and $D(2,1;\alpha)$.

V. Serganova *Classical superalgebras at infinity*

In the recent paper by I. Penkov, E. Dan-Cohen and the author certain tensor Koszul categories of representations over $sl(\infty), sp(\infty)$ and $so(\infty)$ were introduced and studied. In this talk I discuss a generalization of these categories to the Lie superalgebras $sl(\infty,\infty), osp(\infty,\infty), P(\infty)$ and $Q(\infty)$. It turns out that essential difficulties of representations of those superalgebras at finite level disappear at infinity. As an example, I will prove an equivalence of the above categories for $so(\infty), sp(\infty), osp(\infty)$ and $P(\infty)$. Then I will talk about the most interesting case of $Q(\infty)$.

A. Sergeev *Lie superalgebras and quantum integrable systems*

Abstract. We show that for the root system of any simple basic classical Lie superalgebra one can construct a deformed integrable version of the quantum Calogero-Moser-Sutherland operator. We also consider some infinite-dimensional generalisations of the latter operator. Eigenfunctions are investigated with their relations to representation theory. This talk is based on a joint work with A. Veselov.

D. Valeri *Classical W-algebras within the theory of Poisson vertex algebras*

Abstract.The aim of the talk is to give a definition of classical W-algebras in the framework of Poisson vertex algebra theory and use the so-called Lenard-Magri scheme of integrability to get some applications to the theory of integrable Hamiltonian equations.

J. van Ekeren *Modularity for vertex algebras*

M. Wakimoto *Representations of affine Lie superalgebras and mock modular forms (joint work with Victor Kac) — in the cases of* $\hat{sl}(2|1)$ *and* $\hat{A}(1,1)$ —

Abstract . As it is well known, the space of characters of admissible representations of affine Lie algebras for each level is invariant under the action of $SL(2, Z)$. But this fails to hold for Lie superalgebras, where characters are written by the Appell's functions and their modular properties are quite unclear. But recently the breakthrough was brought by the Zwegers' work. It seems that, using and extending Zwegers' methods, we will have beautiful scope of mock modular forms for affine Lie superalgebras. In this talk I would explain it in the cases of the simplest affine Lie superalgebras $\hat{sl}(2|1)$ and $\hat{A}(1,1)$, from which we obtain "mock modular series" of the N=2 and N=4 superconformal algebras respectively. This work was motivated by emails from Ken Ono and Amanda Folsom informing on their works. I thank them for calling our attention to mock modular forms.

R. Zhang *Deformed category* $\mathcal{O}$ *of Lie superalgebras.*

Abstract. We develop a theory for a deformed category $\mathcal{O}$ of any finite dimensional simple Lie superalgebra $\mathfrak{g}$. This enables us to introduce Jantzen filtrations for generalized Verma modules of g and prove an analogue of the Jantzen conjecture when g is of type I. The deformation theory also allows for a better understanding of the projective objects in $\mathcal{O}$ and helps to describe the center of the category. This is joint work with Yucai Su.

POSTERS

S. Kwok *Super Morita Theory*

C. Martinez *Representation theory of the Lie Algebra* $\mathfrak{Sl}_\mathfrak{n}$

Z. Shaikh *Superbosonisation, Laplace Transforms and Lowest Weight Representations*