Lie Theory
Théorie de Lie
(Org: **Terry Gannon** and/et **Nicolas Guay** (Alberta))

KATRINA BARRON, University of Notre Dame and The Max Planck Institute
On certain constructions of supersymmetric vertex operator superalgebras and twisted sectors

We will discuss some constructions of vertex operator superalgebras arising in superconformal field theory as well as certain twisted and untwisted modules for these vertex operator superalgebras which naturally arise for instance when constructing genus-one and higher genus superconformal correlation functions.

YULY BILLIG, Carleton University
Representation of Lie algebras of vector fields on loop manifolds

Let $\hat{X}$ be the cartesian product of an algebraic manifold X with a circle S^1. We construct a sheaf of vertex algebras on X and the sheafs of chiral tensor modules, generalizing the construction of the chiral de Rham complex, introduced by Malikov-Schechtman-Vaintrob. We show that chiral tensor modules admit the action of the sheaf of Lie algebras of vector fields on $\hat{X}$.

ERIK CARLSSON, northwestern
grassmannians and vertex operators

there is a fascinating and well-studied relationship between the cohomology groups of the hilbert scheme of points on a complex surface, and 2-dimensional conformal field theory. in particular, vertex operators assist in calculations of cup product constants of canonical cohomology classes, and conversely, geometric correspondences on the hilbert scheme give new formulas for vertex operators. I'll present an analogous picture where the moduli space is the infinite sato grassmannian, and show that many of the defining properties of vertex operator algebras follow from geometric considerations.

SCOTT CARNAHAN, IPMU, University of Tokyo
Conformal blocks on nodal curves

Frenkel and Ben-Zvi gave a method for attaching a space of conformal blocks to the data of a smooth complex algebraic curve, a quasi-conformal vertex algebra, and modules placed at points. Furthermore, when the vertex algebra has conformal structure, one obtains sheaves of conformal blocks with projectively flat connection on moduli spaces of smooth curves with marked points. I'll describe how logarithmic geometry can be employed to canonically extend these sheaves to the semistable locus, where the connection acquires at most logarithmic singularities. When one has a finite group G acting by automorphisms of the conformal vertex algebra, one may construct G-equivariant intertwining operators by varying ramified G-covers of the projective line.

GERALD CLIFF, University of Alberta
Super and q Schur algebras

We review the definitions and properties of Schur algebras, q-Schur algebras, and Schur superalgebras. We define the q-Schur superalgebra $S_q(m|n,r)$ and discuss some of its properties. When q is a root of unity, $S_q(m|n,r)$ is not cellular or quasi-hereditary in general. This can be shown using the quantum Frobenius map and a version of Steinberg's tensor product theorem.

CLIFTON CUNNINGHAM, University of Calgary
Geometrization of two stably-conjugate, self-dual distributions on p-adic $sl(2)$

Admissible distributions which are eigenfunctions of the Fourier transform on p-adic Lie algebras play an important role in representation theory. This talk concerns two such distributions on p-adic $sl(2)$, related by stable conjugacy and tied to the Lusztig function for $sl(2)$. I will exhibit two very special, non-isomorphic Galois perverse sheaves on $sl(2)$ and show how they determine these two stably-conjugate, self-dual distributions.

IVAN DIMITROV, Queen's University
Lagrangian subalgebras of basic classical Lie superalgebras

Lagrangian subalgebras of semisimple Lie algebras have been studied extensively in connection with different problems arising in Physics and Geometry. These subalgebras play a central role in the celebrated classification by Belavin and Drinfeld of quasitriangular Lie bialgebra structures on simple Lie algebras. More recently Evans and Lu showed that the variety of Lagrangian subalgebras is closely related to the wonderful compactification. It is a natural problem to extend the above results to simple Lie superalgebras. In this talk I will present the classification of Lagrangian subalgebras of basic classical Lie superalgebras, paying special attention to the new phenomena that arise in the superalgebra case compared to the classical one.

This is joint work with Milen Yakimov from LSU.

ALEX FEINGOLD, State University of New York at Binghamton
Decomposition of level-1 representations of $D_4^{(1)}$ with respect to its subalgebra $G_2^{(1)}$ in the spinor construction

In Contemp Math, Vol. 121, Feingold, Frenkel and Ries gave a spinor construction of the vertex operator para-algebra $V = V^0 \oplus V^1 \oplus V^2 \oplus V^3$, whose summands are 4 level-1 irreps of the affine Kac-Moody algebra $D_4^{(1)}$. The triality group $S_3 = \langle \sigma, \tau \mid \sigma^3 = 1 = \tau^2, \tau\sigma\tau = \sigma^{-1} \rangle$ in $Aut(V)$ was constructed, preserving V^0 and permuting V^i, $i = 1, 2, 3$. V is $\frac{1}{2}\mathbb{Z}$-graded and V_n^i denotes the n-graded subspace of V^i. Vertex operators $Y(v, z)$ for $v \in V_1^0$ represent $D_4^{(1)}$ on V, while those for which $\sigma(v) = v$ represent $G_2^{(1)}$. V decomposes into the direct sum of $G_2^{(1)}$ irreps by a two-step process, first decomposing with respect to the intermediate algebra $B_3^{(1)}$ represented by $Y(v, z)$ for $\tau(v) = v$. There are three vertex operators, $Y(\omega_{D_4}, z)$, $Y(\omega_{B_3}, z)$, $Y(\omega_{G_2}, z)$, each representing the Virasoro algebra given by the Sugawara constructions from the three algebras. These give two coset Virasoro constructions, $Y(\omega_{D_4} - \omega_{B_3}, z)$ and $Y(\omega_{B_3} - \omega_{G_2}, z)$, with central charges $1/2$ and $7/10$, respectively, the first commuting with $B_3^{(1)}$, the second commuting with $G_2^{(1)}$, and each commuting with the other. This gives the space of highest weight vectors for $G_2^{(1)}$ in V as tensor products of irreducible Virasoro modules $L(1/2, h_1) \otimes L(7/10, h_2)$. This dissertation research of my student, Quincy Loney, explicitly constructs these coset Virasoro operators, and uses them to study the decomposition of V with respect to $G_2^{(1)}$. This work provides a spinor construction of the $c = 7/10$ Virasoro modules inside V, and provides a vertex operator algebra naturally associated with the basic module for $G_2^{(1)}$.

JACOB GREENSTEIN, University of California Riverside
Quantum folding

A classical result in Lie theory stipulates that a simple finite dimensional Lie algebra of type BCFG can be constructed as the subalgebra of a Lie algebra of type ADE fixed by an admissible diagram automorphism of the latter. This construction is called folding and extends to Kac-Moody Lie algebras. Although foldings do not admit direct quantum analogues, it can be shown that there exists an embedding of crystals for the corresponding Langlands dual Lie algebras. The aim of this talk is to introduce algebraic analogues and generalizations of foldings in the quantum setting which yield new flat families of deformations of universal enveloping algebras of non-semisimple Lie algebras and of Poisson algebras. The most spectacular example is a new "quantum matrices" algebra (joint work with A. Berenstein)

MICHAEL LAU, Université Laval
Gelfand-Zetlin system for $GL(\infty)$

In the 1980s, Guillemin and Sternberg constructed an integrable system on the coadjoint orbits of $U(n)$. This is a geometric analogue of the classical Gelfand-Zetlin bases for irreducible representations. A complexified version was later discovered by Kostant and Wallach on the Poisson manifold $\mathfrak{gl}(n)^*$ in 2006. I will describe an infinite-dimensional analogue of this system on coadjoint orbits of $GL(\infty)$ and discuss some of the associated (infinite) Poisson geometry. This talk is based on joint work with Mark Colarusso.

FRANTISEK MARKO, The Pennsylvania State University, Hazleton, USA
Bideterminants for Schur Superalgebras

We will review classical results regarding bideterminants for Schur algebras, the structure of their simple modules and the process of modular reduction. Afterwards, we will define Schur superalgebra $S(m|n,r)$ and its $\mathbb{Z}$-form $S(m|n,r)_{\mathbb{Z}}$, and discuss bideterminants for Schur superalgebras over a field of characteristic zero.

Then we will solve a problem of Muir and describe a $\mathbb{Z}$-form of a simple $S(m|n,r)$-module $D_{\lambda,\mathbb{Q}}$ over the field $\mathbb{Q}$ of rational numbers, under the action of $S(m|n,r)_{\mathbb{Z}}$. This $\mathbb{Z}$-form is the $\mathbb{Z}$-span of modified bideterminants $[T_\ell : T_i]$. Finally, we will prove that each $[T_\ell : T_i]$ is a $\mathbb{Z}$-linear combination of modified bideterminants corresponding to $(m|n)$-semistandard tableaux T_i.
(joint work with Alexandr N. Zubkov)

ERHARD NEHER, University of Ottawa
Finite-dimensional representations of equivariant map algebras

Suppose a finite group acts on an algebraic variety X and a finite-dimensional Lie algebra g. Then the space of equivariant algebraic maps from X to g is a Lie algebra under pointwise multiplication. Examples of such equivariant map algebras include current algebras, twisted and untwisted loop algebras and their multi-variable versions, and the (generalized) Onsager algebra.

In this talk I will present a classification of all finite-dimensional irreducible representations of equivariant map algebras (joint work with Alistair Savage and Prasad Senesi) and describe their extensions (joint work with Alistair Savage). The latter result allows us to determine the block decomposition of the category of all finite-dimensional representations of equivariant map algebras.

JUANA SANCHEZ ORTEGA, University of Malaga (Malaga, Spain)
Finite gradings of Lie algebras

This is a joint work with Mercedes Siles Molina.

We show that the algebra $\mathrm{Der(L)}$ of derivations of a strongly nondegenerate Lie algebra L graded by an ordered group G with a finite grading (and satisfying a mild technical condition) inherites the grading from L, i.e. $\mathrm{Der(L)}$, which turns out to be a strongly nondegenerate Lie algebra, is G-graded and has the same support as L. We specialize the result when L is the Lie algebra of the form A^-/Z_A or K/Z_K, for A a semiprime associative algebra, K the Lie algebra of skew elements of a semiprime associative algebra with involution, and Z_A and Z_K their respectives centers.

ARTURO PIANZOLA, University of Alberta
Derivations, automorphisms and ideals of certain algebras given by descent

I will discuss the topics mentioned in the title. The emphasis is going to be on infinite dimensional Lie algebras related to Extended Affine Lie Algebras. Part of this work (ideals) is joint with Michael Lau.

MARINA TVALAVADZE, University of Saskatchewan

Universal enveloping algebra of a symplectic anti-Jordan triple system

In this work we are concerned with the universal associative envelope of a finite-dimensional symplectic anti-Jordan triple system (AJTS). We prove that if T is a triple system as above, then there exists an associative algebra $U(T)$ and an *injective* homomorphism $\varepsilon : T \to U(T)$ where $U(T)$ is an AJTS under the triple product defined by $(a, b, c) = abc - cba$. Moreover, $U(T)$ is a universal object with respect to such homomorphisms. We explicitly determine PBW-basis of $U(T)$, structure constants and the center $Z(U(T))$.