Invited Speakers' Titles & Abstracts

Georgia Benkart *University of Wisconsin*
"Perfect crystals"

Perfect crystals have remarkable properties. This talk will discuss our recent work with I. Frenkel, Kang and Lee giving a uniform construction of level one crystals for all affine Lie algebras and what they might be trying to tell us.

Stephen Berman *University of Saskatchewan, Canada*
"Covering Algebras"

This talk will discuss a sequence of papers on Covering Algebras by B. Allison, S. Berman, J. Faulkner, and A. Pianzola. The isomorphism question will be dealt with as well as when we get new extended affine Lie algebras from old ones by taking covering algebras. Both the Lie and associative algebra cases are interesting and examples from each will be mentioned.

Richard E. Block *University of California, Riverside*
"Dual coalgebras and cofree coalgebras"

We consider algebras over a principal ideal domain. The algebras considered are linear algebras with one or more multilinear operations, or algebras over a linear operad, and are assumed to be free as modules. We give two characterizations of which elements of the dual space of an algebra are in the dual coalgebra (the upper nought coalgebra), one characterization in terms of the transpose of composite operators (i.e., of elements of the operad) applied to the functional as being decomposable, and the other that the module of translates for each of the composite operators is of finite rank (the translate theorem). We also give a criterion for when the dual coalgebra is locally finite. For varieties defined by multilinear identities (the multilinearity is no restriction at characteristic 0), or equivalently over an operad, we give an explicit description of the corresponding cofree coalgebra on a free module, as certain elements in the dual coalgebra of the free algebra on the module. This generalizes and improves earlier work, over a field, for associative algebras (Block-Leroux) and for general (i.e., no associative or other identities assumed) linear algebras (Block-Griffing).

Vyjayanthi Chari *University of California, Riverside*
"Weyl, Demazure and Kirillov-Reshetikhin modules"

The Weyl modules for the affine algebras were introduced as a tool to study the the irreducible representations of the quantum affine algebra. In this talk we shall see the connections between these modules and Demazure modules in positive level representations of the affine algebra. We shall see also that this allows us to give a presentation of certain Demazure modules and identifies them with the speicializations of the Kirillov-Reshetikhin modules.

Chongying Dong *University of California, Santa Cruz*
"On the uniqueness of the moonshine vertex operator algebra"

Frenkel-Lepowsky-Meurman conjectured in 1988 that the moonshine vertex operator algebra is characterized by three canonical conditions. In this talk we will present proofs of two weak versions of the conjecture.

Rolf Farnsteiner *University of Bielefeld, Germany*
"Affine quivers, polyhedral groups, and representation type"

According to a fundamental theorem by Drozd, the class of finite-dimensional algebras over an algebraically closed field k may be subdivided into the disjoint subclasses of representation-finite, tame, and wild algebras. Algebras of *finite representation type* possess (up to isomorphism) only a finite number of indecomposable modules. A representation-infinite algebra is *tame* if in each dimension all but finitely many isoclasses of indecomposables occur in a finite number of one-parameter families. Since the representation theory of an algebra that does not belong to one of these classes is at least as complicated as that of any other algebra, there seems to be no hope of classifying the indecomposable modules of these so-called *wild* algebras.

Due to the historical origins of the representation theory of non-semisimple associative algebras, group algebras of finite groups have often served as a paradigm for related classes of algebras such as reduced enveloping algebras of restricted Lie algebras or distribution algebras of infinitesimal group schemes. By the same token, much of the initial work in abstract representation theory has focused on the study of hereditary algebras.

The purpose of this talk is to present methods and results concerning the classification of cocommutative Hopf algebras of finite and tame representation type. Being equivalent to representations of finite group schemes, one discerning feature of the module categories of these algebras is the presence of tensor products. In my talk, I will explain some of the ramifications of this additional structure by discussing support varieties, linkage principles and McKay quivers. While the former play an important rôle in the treatment of infinitesimal groups, the latter relate the representation type of finite group schemes to that of hereditary algebras: The blocks of tame finite algebraic groups are either Nakayama algebras or Morita equivalent to certain generalizations of trivial extensions of path algebras of affine quivers of type $\tilde{A}, \tilde{D}, \tilde{E}$. The binary polyhedral groups associated to these quivers largely determine the reduced parts of the underlying finite group schemes

Igor Frenkel *Yale University*
"Instanton and quiver constructions of affine Lie algebra representations and special bases"

Jürgen Fuchs *Karlstads University, Sweden*
"An analogue of the Verlinde formula for non-rational vertex algebras"

For conformal vertex algebras with non-semisimple representation category C, the modular transformations of characters do not furnish a finite-dimensional representation of the modular group SL(2,Z). However, at least for the (1,p) Virasoro minimal models, by separating a suitable (matrix-valued) automorphy factor from these transformations, one can still extract a finite-dimensional SL(2,Z)-representation. Moreover, via a conjectured generalization of the Verlinde formula to the non-semisimple case, this gives rise to fusion rules having the features expected for the Grothendieck ring of C. These fusion rules are in particular non-semisimple, with block structure matching the decomposition structure of the vertex algebra representations.

Howard Garland *Yale University*
"Counting the number of rational points in certain moduli spaces of vector bundles on surfaces"

We will describe how to use Eisenstein series on arithmetic quotients of loop groups to estimate the number of rational points in certain moduli spaces. The connection between Eisenstein series on loop groups and such moduli spaces is due to Kapranov. Our contribution is the meromorphic continuation of such Eisenstein series which allows us to use Wiener-Tauberian theorems, as in the work of Franke,Tschinkel, and Manin, in the case of classical Eisenstein series.

Seok-Jin Kang *Seoul National University, Korea*
"Nakajima's monomials and crystal bases"

We present a new realization of crystal bases for integrable hihgest weight modules over quantum groups using Nakajima's monomials. We also give a characterization of these monomials for classical quantum algebras and quantum affine algebras of type $A_n^{(1)}$. Finally, we construct the crystal basis of the negative part of a quantum group in terms of Nakajima's monomials.

Rinat Kedem *University of Illinois, Urbana-Champaign*
"Kostka polynomials and representations of affine algebras"

In order to compute fermionic characters for arbitrary highest weight representations of affine algebras, one can use the fusion product of simpler modules, and then invert the resulting Kostka matrix. I will explain the reasons for this and give formulas for the characters and Kostka polynomials, both of which are computed using the methods of Feigin and Stoyanovskii.

Alexander Kirillov, Jr. *State University of New York, Stony Brook*
"Wess-Zumino-Witten model as an orbifold theory"

Bertram Kostant *Massachusetts Institute of Technology*
"Powers of the Dedekind-η function and representation theory"

James Lepowsky *Rutgers University*
"Some developments in vertex operator algebra theory, old and new"

I will briefly sketch some themes in the evolution of vertex operator algebra theory, including a selection of current developments.

Haisheng Li *Rutgers University, Camden*
"Quantum vertex algebras associated with Zamolodchikov-Faddeev algebras"

We first define a notion of (weak) quantum vertex algebras and then we give a general construction. As an application, we construct quantum vertex algebras from solutions of the rational quantum Yang-Baxter equation. This construction is motivated by the notion of Zamolodchikov-Faddeev algebra.

Geoffrey Mason *University of California, Santa Cruz*
"Vertex algebras and partition functions"

Partition functions in string theory and conformal field theory are often presented as path integrals. Interpreting them in the framework of vertex algebras is an important and challenging problem.

Olivier Mathieu *Lyon University, France*

TBA

Arne Meurman *Lund University, Sweden*
"On generators and relations for vertex operator algebras"

Tetsuji Miwa *Kyoto University, Japan*
"Sklyanin's algebra and trace functional"

Toshiki Nakashima *Sophia University, Japan*
"Affine Geometric Crystals and Tropical R"

(This is the joint work with M.Kashiwara and M.Okado.) Theory of geometric crystals, which is introduced by A.Berenstein and D.Kazhdan, is certain geometrical analogue of Kashiwara's crystal theory. First, we review the theory of geometric crystals in Kac-Moody setting. We also introduce the notion of tropicalizations(Trop)/ultra-discretizations(UD) procedure. Next, we construct some geometric crystals associated with affine Kac-Moody algebras. And we see that they are tropicalizations of certain limit of perfect crystals. Finally, tropical R for the affine geometric crystals are given explicitly.

Brian Parshall *University of Virginia*
"Some results on Specht modules and algebraic groups"

We will discuss some new properties (and conjectured properties) of Specht modules for symmetric groups (and Hecke algebras) and their relationship to the modular representations of algebraic groups.

Mirko Primc *University of Zagreb, Croatia*
"Combinatorial bases of Feigin-Stoyanovsky type subspaces and interwining operators"

Certain Feigin-Stoyanovsky type subspaces of standard modules for affine Lie algebras have interesting combinatorial bases. In this talk I'll discuss the recent Capparelli-Lepowsky-Milas approach to study these combinatorial bases by using simple currents and coefficients of intertwining operators.

Vladimir Retakh *Rutgers University*
"Factorizations of polynomials over noncommutative rings and algebras associated with quivers"

Factorizations of a polynomial $P(t) \in R[t]$ over an associative algebra R into a product of linear polynomials $(t - a)$ can be described by a directed graph (a quiver). The elements a generate a subalgebra in R called the subalgebra of pseudo-roots of $P(t)$. On the other hand, to any quiver Γ one can associate the universal algebra of pseudo-roots $A(\Gamma)$ generated by edges of the quiver and called the universal algebra of pseudo-roots. Algebras $A(\Gamma)$ and their quadratic dual algebras have may interesting properties that will be discussed in the talk. This is a joint project with I. Gelfand, S. Serconek,and R. Wilson.

Christoph Schweigert *University of Hamburg, Germany*
"Twining characters and Picard groups in rational conformal field theories"

Picard groups of tensor categories play an important role in rational conformal field theories. The Picard group of the representation category $\mathcal{C}$ of a rational vertex algebra provides a handle to construct (symmetric special) Frobenius algebras in $\mathcal{C}$. Such an algebra A encodes all data needed to ensure the existence of correlators of a local conformal field theories. The Picard group of the category of A-bimodules has a physical interpretation: it describes the internal symmetries of the theory and allows one to identify generalized Kramers-Wannier dualities of the theory.

In the application of these general results to concrete models based on affine Lie algebras, a detailed knowledge of certain representations of the modular group is needed. We discuss conjectures that relate these representations to the one provided by twining characters of affine Lie algebras.

Helmut Strade *Univeristy of Hamburg, Germany*
"The classification of the simple Lie algebras over fields of positive characteristic: history, state of art, outlook"

We will describe some historical and mathematical steps toward the classification of the mentioned algebras; we present the examples and the final results for characteristic $p > 3$; we will discuss the next steps for the very small characteristics.

Monica Vazirani *University of California, Davis*
"Vanishing integrals of Macdonald polynomials"

If one integrates a Schur function s_λ over the orthogonal group, the integral is zero unless λ has all parts even. A similar statement is true for Macdonald polynomials, where one modifies the density appropriately. This modification is dictated by the representation theory of the affine Hecke algebra. This is joint work with E. Rains.

Weiqiang Wang *University of Virginia*
"Hilbert schemes, vertex operators, and integrable hierarchies"

We formulate a generating function of equivariant intersection numbers on the Hilbert schemes of points on the affine plane. We then show that it is a τ-function of 2-Toda hierarchy via a (vertex) operator formalism.

Robert Wilson *Rutgers University*
"Modules and combinatorial identities"

We discuss relations between combinatorial identities and the graded dimensions of modules for Lie algebras and related structures.