

Talk Abstracts

Vertex Algebras in Higher Dimensions

Friday, July 11, 9:30am-10:00am

Bojko Bakalov

North Carolina State University

Abstract: *The notion of a vertex algebra in dimension D differs from the usual one by replacing the formal variable z with a vector $z = (z^1, \dots, z^D)$ and expressions like $z - w$ with the square length of the vector $z - w$. When equipped with an action of the Lie algebra of infinitesimal conformal transformations, such vertex algebras arise in globally conformal invariant quantum field theory in dimension D . In this talk I will review the theory of these vertex algebras and present examples related to infinite-dimensional Lie algebras.*

Vector-valued Modular Forms and the Hypergeometric Equation

Friday, July 11, 8:30am-9:20am

Peter Bantay

Eötvös Loránd University, Hungary

Abstract: *We present the results of joint work with T. Gannon on vector-valued modular forms: we explain the basic notions and results of the theory, in particular the hypergeometric equation satisfied by the fundamental matrix, the inversion formula and the spectral condition. The general theory is illustrated on some simple examples.*

Uniformization of Genus-zero and Genus-one $N = 2$ Super-Riemann Surfaces and Implications for Superconformal Field Theory

Monday, July 7, 11:30am-12:00pm

Katrina Barron

University of Notre Dame

Abstract: *We present a uniformization theorem for genus-zero and genus-one $N = 2$ superconformal super-Riemann surfaces. In particular, in the genus-zero case, the classification up to $N = 2$ superconformal equivalence is by holomorphic line bundles over the Riemann sphere. In the genus-one case, there are two families of $N=2$ superconformal equivalence classes, one of which is given by holomorphic line bundles over the underlying complex torus which are classified by theta functions. We will discuss implications for $N = 2$ superconformal field theory and the theory of $N = 2$ superconformal vertex operator superalgebras.*

Two new results on spanning sets for vertex operator algebras and their quasimodules

Wednesday, July 9, 11:05am-11:35am

Geoffrey Buhl

California State University Channel Islands

Abstract: Quasimodules for vertex operator algebras arise naturally from a generalization of locality. In this talk I present two new results on spanning sets for vertex operator algebras and quasimodules. Quasimodules are spanned by elements satisfying a difference-one ordering restriction. For a suitably chosen generating set, vertex operator algebras are spanned by elements satisfying arbitrary difference conditions.

Vertex-algebraic Structure of Certain Modules for Affine Lie Algebras

Thursday, July 10, 10:30am-11:00am

Corina Calinescu

Ohio State University

Abstract: We discuss vertex-algebraic structure of the principal subspaces of standard modules for certain affine Lie algebras. We give suitable presentations of these subspaces and derive recursions satisfied by the graded dimensions of the principal subspaces.

Part of this talk is based on joint work with J. Lepowsky and A. Milas.

Realizations of elliptic affine $sl(2)$

Tuesday, July 8, 4:35pm-5:05pm

Ben Cox

The College of Charleston

Abstract: I will discuss recent work with A. Bueno and V. Futorny on a free field realization of the elliptic affine Lie algebra of $sl(2)$.

Rational Vertex Operator Algebras with Central Charges 1

Wednesday, July 9, 3:00pm-3:50am

Chongying Dong

University of California at Santa Cruz

Abstract: We will discuss some recent progress on classification of the rational vertex operator algebras with central charges 1.

Hyperbolic Weyl Groups and the Four Normed Division Algebras

Tuesday, July 8, 3:00pm-3:50am

Alex Feingold

Binghamton University

Abstract: *We study the Weyl groups of hyperbolic Kac-Moody algebras of ‘over-extended’ type and ranks 3, 4, 6 and 10, which are intimately linked with the four normed division algebras $K = R, C, H, O$, respectively. A crucial role is played by integral lattices of the division algebras and associated discrete matrix groups. Our findings can be summarized by saying that the even subgroups, W^+ , of the Kac-Moody Weyl groups, W , are isomorphic to generalized modular groups over K for the simply laced algebras, and to certain finite extensions thereof for the non-simply laced algebras. This hints at an extended theory of modular forms and functions. The talk is based on the joint paper (see arXiv:0805.3018 [math.RT]) with Axel Kleinschmidt, Hermann Nicolai.*

Trees, Permutations, and Bidendriform Bialgebras

Loic Foissy

Tuesday, July 8, 10:30am-11:00am

Université de Reims, France

Abstract: *We first describe the non-commutative Connes-Kreimer Hopf algebra of trees, then the Hopf algebra of free quasi-symmetric functions, also known as the Malvenuto-Reutenauer Hopf algebra, bases on permutations. We finally show that they are related, using non associative structures.*

C_{11} , C_2 , and Twisted Representations

Monday, July 7, 10:30am-11:20am

Terry Gannon

University of Alberta, Canada

Abstract: *Zhu assigned two algebras to a VOA: one (called Zhu’s algebra or C_{11}) exactly models the representation theory of the VOA, while the other (called C_2) is graded and therefore easier to compute. In a rational VOA, $\dim(C_{11}) \leq \dim(C_2) < \infty$, and many familiar VOAs have equality there. In my talk I’ll summarize joint work with Matthias Gaberdiel, in which we compare C_{11} and C_2 for the lattice and affine algebra VOAs, and interpret any discrepancy present using twisted representations.*

V_L^+ -modules and Weak Hopf Algebras (work in progress)

Tuesday, July 8, 11:05am-11:35am

Christopher Goff

University of the Pacific

Abstract: *This talk will discuss the fusion algebra of the VOA V_L^+ in the case when L is a rank 1 even lattice and will present partial results toward finding a weak Hopf algebra whose fusion algebra is isomorphic to that of V_L^+ .*

Extensions of Weight Modules of Lie Algebras

Wednesday, July 9, 10:30am-11:00am

Dimitar Grantcharov

University of Texas, Arlington

Abstract: *Following works of G. Benkart, D. Britten, S. Fernando, V. Futorny, F. Lemire, A. Joseph and others, in 2000, O. Mathieu achieved a major breakthrough in the representation theory by classifying all simple weight modules of reductive Lie algebras. In this talk we will discuss the recent developments of Mathieu's ideas and methods. More precisely, results related to the structure of the indecomposable weight modules will be presented. These results are a part of an ongoing joint project with V. Serganova.*

Extremal Vertex Operator Algebras

Monday, July 7, 4:00pm-4:30:pm

Gerald Hoehn

Kansas State University

Abstract: *Extremal vertex operator algebras are self-dual vertex operator algebras of central charge c for which the smallest degree of a Virasoro primary vector different from the vacuum is $[c/24] + 1$. They have been first considered in my 1995 Ph.D. thesis.*

In the talk, I will discuss my application of extremal vertex operator algebras to conformal designs and the recently found application to pure 3-dimensional quantum gravity by E. Witten.

Hopf Algebras of Rooted Trees and the Hopf Algebras of Symmetric Functions

Tuesday, July 8, 2:00pm-2:50pm

Michael Hoffman

U. S. Naval Academy

Abstract: Recent work in perturbative quantum field theory has led to much study of the Connes-Kreimer Hopf algebra. Its (graded) dual, the Grossman-Larson Hopf algebra of rooted trees, was already known to algebraists. L. Foissy introduced a noncommutative version of the Connes-Kreimer Hopf algebra, which turns out to be self-dual. Using some homomorphisms defined by the author and W. Zhao, we describe a commutative diagram that relates the aforementioned Hopf algebras to each other and to the Hopf algebras of symmetric functions, noncommutative symmetric functions, and quasi-symmetric functions.

Deformed W Algebras and Tableau Description of Macdonald Polynomials

Monday, July 7, 5:10pm-5:40pm

Ayumu Hoshino

Sophia University, Japan

Abstract: We give the tableau description of Macdonald polynomials of type A by using the fusion construction for the free field realization of deformed W algebra. Frenkel and Reshetikhin constructed the deformed W algebras associated to simple Lie algebras. We obtain the tableau description of Macdonald polynomials of type D for some dominant integral weights by using the fusion construction for the free field realization of deformed W algebra of type.

Representations of Vertex Operator Algebras and Finite Braided Tensor Categories

Monday, July 7, 9:30am-10:20am

Yi-Zhi Huang

Rutgers University, New Brunswick.

Abstract: *A finite braided tensor category is a rigid braided tensor category such that every object is of finite length, every space of morphisms is finite dimensional, there are finitely many inequivalent irreducible objects and every irreducible object has a projective cover. I will start with a summary of the representation theory of vertex operator algebras satisfying the positive energy, C_2 -cofiniteness and reductivity conditions. Based on the tensor product theory for modules for a vertex operator algebra developed by Lepowsky and me, I have proved that the category of modules for such a vertex operator algebra has a structure of modular tensor category, which, in particular, is a semisimple finite braided tensor category. I will discuss a generalization of the representation theory of these vertex operator algebras to vertex operator algebras satisfying certain finiteness, cofiniteness and grading-reality conditions, but not any reductivity condition, based on the logarithmic tensor product theory developed by Lepowsky, Zhang and me. In particular I have recently proved that the category of modules is a (not necessarily semisimple) finite braided tensor category, except that the rigidity is still conjectural.*

A moonshine highest-weight vector for every cusp form?

Thursday, July 10, 11:05am-11:35am

Kate Hurley

Georgia Institute of Technology

Abstract: *In their paper "Monstrous moonshine of higher weight," Dong and Mason conjecture that for any cusp form, there exists a monster-invariant highest-weight vector in the moonshine module with 1-point function equal to that cusp form. We explicitly find some such highest-weight vectors.*

Recurrence Relations for Characters of Affine Lie Algebra $A_\ell^{(1)}$

Friday, July 11, 10:45am-11:15pm

Miroslav Jerkovic

University of Zagreb, Croatia

Abstract: *By using the known description of combinatorial bases for Feigin-Stoyanovsky's type subspaces of standard modules for affine Lie algebra $\mathfrak{sl}(l+1, \mathbb{C})$, as well as certain intertwining operators between standard modules, we obtain exact sequences of Feigin-Stoyanovsky's type subspaces at fixed level k . This directly leads to systems of recurrence relations for formal characters of those subspaces. Particularly, by solving the above mentioned system for affine Lie algebra $\mathfrak{sl}(3, \mathbb{C})$ we obtain fermionic type character formulas for all Feigin-Stoyanovsky's type subspaces at general level.*

A free field realization of toriodal sl_n

Tuesday, July 8, 4:00pm-4:30pm

Elizabeth Jurisich

The College of Charleston

Abstract: A representation of the toriodal Lie algebra as series of non-commuting differential operators acting on polynomial rings in many variables is presented.

Generalized Modular Forms

Thursday, July 10, 2:00pm-2:50pm

Marvin Knopp

Temple University

Generalized Modular Functions, Their Fourier Coefficients and Vertex Operator Algebras

Thursday, July 10, 3:00pm-3:50am

Winfried Kohlen

Universität Heidelberg, Germany

Abstract: Generalized modular functions are holomorphic functions on the complex upper half-plane that satisfy the usual definition of a modular function except that the character need not be unitary. There are connections to physics via the theory of vertex operator algebras. We will give some properties of their Fourier coefficients. In particular we will show (under certain conditions) that these are badly behaved, in a sense to be made precise, unless they are really classical modular functions. This is joint work with G. Mason.

On Mckay's E_7 and E_6 Observations

Monday, July 7, 4:35pm-5:05pm

Ching Hung Lam

National Cheng Kung University, Taiwan

Abstract: In this talk, we will discuss McKay's E_7 and E_6 observations on Babymonster and the Fisher group Fi_{24} using certain inductive structures of the Moonshine VOA.

Logarithmic tensor product theory for vertex operator algebra modules

Wednesday, July 9, 2:00pm-2:50pm

Jim Lepowsky
Rutgers University

Abstract: *I will sketch certain features of the logarithmic tensor product theory, developed jointly with Yi-Zhi Huang and Lin Zhang, for suitably general module categories for a vertex algebra of a suitably general type. This generalization of the construction of braided tensor categories, and vertex tensor categories, of modules developed in earlier joint work with Huang does not require the modules to be completely reducible, and is quite a bit more elaborate than that earlier theory. In the analogy between vertex operator algebra theory and Lie algebra theory, this general theory is essentially analogous to the representation theory of general Lie algebras rather than that of semisimple Lie algebras, but in the classical Lie algebra setting, constructing the tensor category of modules for a Lie algebra is a trivial classical procedure, while here, such a construction is a highly nontrivial problem (as it was in the completely reducible case as well). The solution of this problem for the appropriate module categories, although complex and involved, has natural motivation. “Logarithmic formal calculus” and vertex-operator-algebraic formal calculus combined with some rather delicate analysis are required. I will also briefly discuss some related results and some applications of this work.*

Quantum Vertex Operator Algebras and Modules

Wednesday, July 9, 4:00pm-4:50pm

Haisheng Li
Rutgers University at Camden

Abstract: *My talk is based on a recent paper on quantum vertex operator algebras. In this paper, we study notions of \hbar -adic nonlocal vertex algebra and \hbar -adic (weak) quantum vertex algebra, slightly generalizing Etingof-Kazhdan’s notion of quantum vertex operator algebra. For any topologically free $C[[\hbar]]$ -module W , we study \hbar -adically compatible subsets and \hbar -adically S -local subsets of $(\text{End}W)[[x, x^{-1}]]$. We prove that any \hbar -adically compatible subset generates an \hbar -adic nonlocal vertex algebra with W as a module and that any \hbar -adically S -local subset generates an \hbar -adic weak quantum vertex algebra with W as a module. A general construction theorem of \hbar -adic nonlocal vertex algebras and \hbar -adic quantum vertex algebras is obtained. As an application we associate the centrally extended double Yangian of \mathfrak{sl}_2 to \hbar -adic quantum vertex algebras.*

**Algebraic, Geometric, and Representation Theory Approaches to Bases
of Affine Quantum Groups**

Monday, July 7, 3:00pm-3:50pm

Zongzhu Lin

Kansas State University

Abstract: *For finite dimensional semisimple Lie algebras, the Chevalley basis will give PBW bases to PBW bases for quantum groups and the canonical bases. Other types of root systems there are many different ways to construct bases to the quantum groups. In the talk several ways of such constructions will be mentioned and their relations will be explored in terms of canonical bases. These approaches include the algebraic ways using the generator relations, complexes of sheaves over certain algebraic varieties, and Hall algebras of the representations of quivers*

Invariant Chiral Differential Operators

Thursday, July 10, 11:40am-12:10pm

Andrew R. Linshaw

University of California at San Diego

Abstract: *Given a finite-dimensional Lie algebra g and a g -module V , the ring $D(V)^g$ of invariant differential operators is a much-studied object in classical invariant theory. It has a natural vertex algebra analogue. First, $D(V)$ has a VA analogue $S(V)$ known as a $\beta\gamma$ -system or algebra of chiral differential operators. The action of g on V induces an action of the corresponding affine algebra on $S(V)$. The invariant space $S(V)^{g^{[t]}}$ is a commutant subalgebra of $S(V)$, and plays the role of $D(V)^g$. I'll describe $S(V)^{g^{[t]}}$ in some basic but nontrivial cases. The answer can be a surprise: for example, when $g = C = V$, $S(V)^{g^{[t]}}$ is the Zamolodchikov W_3 algebra with central charge $c = -2$.*

On the Coefficients of Modular Forms for Noncongruence Subgroups

Thursday, July 10, 4:00pm-4:30pm

Ling Long

Iowa State University

Abstract: *Among all finite index subgroups of the modular group, majority of them are noncongruence. In this talk, we will discuss some results joint with Chris Kurth on an arithmetic property which may potentially characterize genuine noncongruence modular forms with algebraic coefficients.*

On Products of Two Eisenstein Series and Spaces of Cusp Forms

Thursday, July 10, 4:35pm-5:05pm

Yves Martin

Universidad de Chile, Chile

Abstract: *In this talk we give an explicit set of generators for the space of cusp forms of odd prime level and even weight > 3 whose elements are the cuspidal parts of products of two Eisenstein series. We also give a description of the orthogonal projection onto the subspace of new forms and in this way obtain a “simple” set of generators for the latter space.*

On the Transformation Property of the Lie Algebras Associated with Vertex Operator Algebras

Thursday, July 10, 8:30am-9:20am

Atsushi Matsuo

The University of Tokyo, Japan

Abstract: *An explanation will be given for the coordinate-independence of the Lie algebra associated with a vertex operator algebra within the theory of vertex operator algebras.*

Triplet and Super Triplet Vertex Algebras, Quantum Groups and Modular Forms

Wednesday, July 9, 5:00pm-5:30pm

Antun Milas

University at Albany (SUNY)

Abstract: *I will discuss a conjectural equivalence between the category of finite-dimensional $U_q(\mathfrak{sl}_2)$ -modules at root of unity and the category of f.g. modules for the triplet vertex algebra $W(p)$. Some progress towards the conjecture will be presented, by studying primarily the vertex algebra side (properties of modules, characters, pseudocharacters). A few applications and generalizations will be also presented.*

Fermionic Realization of Some Toroidal Lie Algebras

Wednesday, July 9, 8:30am-9:20am

Kailash Misra

North Carolina State University

Abstract: *Toroidal Lie algebras are natural generalizations of affine Lie algebras. We use the fermionic construction of Feingold-Frenkel to realize toroidal Lie algebras of types ABD . This is joint work with N. Jing.*

Orthogonal Representations of Hopf Algebras

Tuesday, July 8, 8:30am-9:20am

Susan Montgomery

University of Southern California

Abstract: *Let H be a Hopf algebra over the complex numbers k , such that the antipode of H has period 2 (such H include enveloping algebras of Lie algebras and all finite-dimensional semisimple Hopf algebras). If V is a finite-dimensional self-dual representation of H , then it is known that V must be either orthogonal or symplectic, in the sense that it admits a non-degenerate H -invariant bilinear form which is either symmetric or skew-symmetric. Classically, the group algebra kG of a finite real reflection group is “totally orthogonal”, in that all of its irreducible representations are orthogonal.*

We consider various Hopf algebras constructed from finite groups, such as the Drinfel'd double of a group, and investigate when they are totally orthogonal in the above sense.

Congruence Subgroups and Generalized Frobenius-Schur Indicators

Tuesday, July 8, 11:40am-12:10pm

Siu-Hung Ng

Iowa State University

Abstract: *The module categories of some VOAs are known to be modular tensor categories. There is a natural projective representation of $SL(2, Z)$ associated with each modular tensor category. The kernel of this projective modular representation is a congruence subgroup of level N where N is the Frobenius-Schur exponent of the category. This projective modular representation can be lifted to an ordinary modular representation with a finite image. If the modular tensor category is the quantum double of a spherical fusion category, then there is a canonical lifting of the projective modular representation whose kernel is a congruence subgroup of level N . In this talk, we will discuss these results in relation to generalized Frobenius-Schur indicators for pivotal categories.*

The talk is part of joint work with Peter Schauenburg.

Lie Idempotents and Renormalization in pQFT

Tuesday, July 8, 9:30am-10:20am

Frédéric Patras

Université de Nice (France) and CNRS

Abstract: *The Hopf algebraic approach to perturbative quantum field theory, as originated by A. Connes and D. Kreimer, has lead recently to various important advances, both in the understanding of high energy physics and in mathematics (combinatorial Hopf algebras, special functions...). For example, the study of the structure of Hopf algebras of trees and graphs has given rise to surprising new combinatorial results on these objects (e.g. with Foissy's recent theorems on the structure of the Malvenuto-Reutenauer Hopf algebra). We will consider here another aspect of the theory, namely the possibility to use the classical Lie idempotents (Dynkin, Solomon, Zassenhaus) to understand some fine features of the renormalization process. A particular emphasis will be put on the Bogoliubov recursion and locality phenomena. These results lead, among others, to a non commutative generalization of the classical Spitzer formulas of fluctuation theory.*

Based on joint works with K. Ebrahimi-Fard, J. Gracia-Bondia and D. Manchon.

On a Class of Infinite-dimensional Lie Algebras Related to Semisimple Lie Algebras

Wednesday, July 9, 9:30am-10:20am

Vladimir Retakh

Rutgers University, New Brunswick

Abstract: *For any Lie algebra g sitting inside an associative algebra A and any associative algebra R we introduce and study Lie algebra $(g, A)(R)$ as the Lie subalgebra of $R \otimes A$ generated by $R \otimes g$. In most examples A is the universal enveloping algebra of g . Our description of algebra $(\gg, A)(R)$ has a striking resemblance to the commutator expansions of R used by M. Kapranov in his approach to noncommutative geometry and somehow reminds a construction of affine Lie algebras. To each algebra $(g, A)(R)$ we associate a "noncommutative algebraic" group which naturally acts on $(g, A)(R)$ by conjugations and conclude the paper with a some examples of such groups.*

(joint paper with A. Berenstein from U. of Oregon)

New Perspectives on exponentiated derivations, the formal Taylor theorem and Faà di Bruno's formula

Tuesday, July 8, 5:10pm-5:40pm

Thomas Robinson
Rutgers University

Abstract: *This talk will concern some ideas initially suggested by some elementary issues in the formal calculus underlying vertex algebras. I shall argue that the definition of expressions like $(x + y)^n$, n a complex number, and $\log(x + y)$ ought to be made more canonical and hopefully more efficient, by using exponentiated derivations and the formal Taylor theorem as the guide. This is a slight change from the usual definitions which are based on formal analytic expansions. Next I will show a close relationship between $\exp(yd/dx)$ and $\exp(yxd/dx)$ using intertwining substitution maps. Then I will mention some combinatorial applications and also how variants of such intertwining substitution maps are connected to Faà di Bruno's formula and the Umbral Calculus.*

Moonshine for Conway's Group

Wednesday, July 9, 11:40am-12:30pm

Nils Scheithauer
University of Edinburgh

Abstract: *The physical states of a bosonic string moving on a 26-dimensional torus form an infinite dimensional Lie algebra called the fake monster algebra. This Lie algebra is a generalized Kac-Moody algebra. Its real simple roots correspond to the Leech lattice. The automorphism group of the Leech lattice acts by diagram automorphisms on the fake monster algebra. We show that the corresponding twisted denominator identities are automorphic forms of singular weight on orthogonal groups.*

Combinatorial Bases of Feigin-Stoyanovsky's Byge Subspaces of Standard Modules for $\tilde{\mathfrak{sl}}_{\ell+1}(\mathbb{C})$

Friday, July 11, 11:20am-11:50pm

Goran Trupcevic
University of Zagreb, Croatia

Abstract: *Let $\tilde{\mathfrak{g}}$ be an affine Lie algebra of type $A_{\ell}^{(1)}$. Suppose we are given a \mathbb{Z} -gradation of the associated simple finite-dimensional Lie algebra $\mathfrak{g} = \mathfrak{g}_{-1} \oplus \mathfrak{g}_0 \oplus \mathfrak{g}_1$; then we also have the induced \mathbb{Z} -gradation of the affine Lie algebra $\tilde{\mathfrak{g}} = \tilde{\mathfrak{g}}_{-1} \oplus \tilde{\mathfrak{g}}_0 \oplus \tilde{\mathfrak{g}}_1$.*

Let $L(\Lambda)$ be a standard module for $\tilde{\mathfrak{g}}$. Feigin-Stoyanovsky's type subspace $W(\Lambda)$ is the $\tilde{\mathfrak{g}}_1$ -submodule of $L(\Lambda)$ generated by the highest-weight vector v_{Λ} , $W(\Lambda) = U(\tilde{\mathfrak{g}}_1) \cdot v_{\Lambda} \subset L(\Lambda)$. We find a combinatorial basis of $W(\Lambda)$, given in terms of certain difference and initial conditions. Linear independence of the generating is proved inductively using coefficients of certain intertwining operators. A basis for the whole module $L(\Lambda)$ can be obtained as an inductive limit of translates of the basis for $W(\Lambda)$.

Exceptional VOAs and the Virasoro Algebra

Monday, July 7, 8:30am-9:20am

Michael Tuite

National University of Ireland, Ireland

Abstract: *We consider a family of exceptional Vertex Operator Algebras (VOAs) where certain Casimir vectors (which are invariant under the VOA automorphism group) are Virasoro descendents of the vacuum. We discuss resulting constraints on the Lie and Griess algebra structures, the partition function and the automorphism group. Examples include the Wess-Zumino-Witten model for Deligne's list of exceptional Lie algebras, the Moonshine Module and Witten's extremal VOAs.*

Andrews' analytic generalizations of the Roger-Ramanujan identities and certain representations of $A_1^{(1)}$

Monday, July 7, 2:00pm-2:50pm

Robert Wilson

Rutgers University

Abstract: *Certain important power series identities (in particular, the Rogers-Ramanujan identities and their combinatorial generalizations by Andrews, Gordon and Bressoud) have been explained in terms of filtrations of standard modules for affine Lie algebras (in particular, $A_1^{(1)}$). Andrews has given another generalization of the Rogers-Ramanujan identities in which the sum side is replaced by a multisum:*

$$\prod_{n>0, n \neq 0, \pm k_0 \pmod{2k+1}} (1 - q^n)^{-1} = \sum_{n_1, \dots, n_{k-1} \geq 0} \frac{q^{N_1^2 + N_2^2 + \dots + N_{k-1}^2 + N_{k_0} + N_{k_0+1} + \dots + N_{k-1}}{(q; q)_{n_1} (q; q)_{n_2} \dots (q; q)_{n_{k-1}}}$$

where $1 \leq k_0 \leq k, k \geq 2$, and $N_j = n_j + \dots + n_{k-1}$. We give an interpretation of this expression using the operators $X^{(i)}$ introduced by Meurman and Primc on a standard $A_1^{(1)}$ -module V_Λ .

W-algebras Related to Parafermion Algebras

Thursday, July 10, 9:30am-10:20am

Hironmichi Yamada

Hitotsubashi University

Abstract: We consider the commutant of a Heisenberg algebra in a simple vertex operator algebra $L(k, 0)$ associated to an affine Lie algebra \widehat{sl}_2 with level k , where k is an integer greater than 1. Its central charge is $2(k-1)/(k+2)$. It is known that the commutant contains Virasoro primary vectors W^3 , W^4 and W^5 of weight 3, 4 and 5, respectively. In fact, the commutant is expected to be generated by the conformal vector and these three Virasoro primary vectors. In the case $k = 2, 3$, or 4, the commutant is well-known, namely, it is isomorphic to the Virasoro vertex operator algebra of central charge $1/2$, the 3-state Potts model, or $V_{\mathbb{Z}\beta}^+$ with $\langle \beta, \beta \rangle = 6$. We study the cases $k = 5$ and 6. The classification of irreducible modules, together with the C_2 -cofiniteness and the rationality is established for $k = 5, 6$. Our argument is based on a detailed analysis of some singular vectors. We will show our results and discuss some problems for a general k .

This is a joint work with Chongying Dong and Ching Hung Lam.

A Characterization of the Moonshine Vertex Operator Algebra by Means of Virasoro Frames

Friday, July 11, 10:05am-10:35am

Hiroshi Yamauchi

Aichi University of Education

Abstract: Frenkel, Lepowsky and Meurman conjectured in the introduction of their monumental book that the moonshine vertex operator algebra can be characterized by the three conditions:

- (a) the VOA itself is the unique irreducible module;*
- (b) the central charge is 24;*
- (c) trivial weight one subspace.*

These conditions are natural analogues of conditions which characterize the binary Golay code and the Leech lattice. Given the validity of their conjecture, the Monster then arise as the automorphism group of a unique structure, like as the largest Mathieu group and the largest Conway group arise on the corresponding unique structures. This conjecture still remains open up to now.

In this talk, I would like to report our result about a characterization of the moonshine vertex operator algebra by means of Virasoro frames. The theory of vertex operator algebras has developed a lot and two results has been established concerning the FLM conjecture. One is due to Dong, Griess and Lam where they gave a characterization by means of the Griess algebra. On the other hand, I and Lam gave a characterization by means of Virasoro frames. In both approaches, certain involutions play a crucial role so I will also discuss about involutions of vertex operator algebras.

Vertex Algebras of Differential Operators over Algebraic Groups

Friday, July 11, 11:55am-12:25pm

Minxian Zhu

Yale University

Abstract: In this talk, we will discuss a family of vertex algebras associated to an algebraic group. We call them vertex algebras of differential operators because they are analogs, in the world of vertex algebras, of the classical algebra of differential operators. These algebras admit two commuting actions of the affine Lie algebra in dual levels. When the levels are generic, the vertex operators can be constructed by intertwining operators between Weyl modules and the Knizhnik-Zamolodchikov equations appear in the locality of these vertex operators. I will also discuss the connection of these vertex algebras with regular representations of the quantum group via the standard semi-regular module of the affine Lie algebra and the Kazhdan-Lusztig equivalence of categories. In particular, I will describe nice filtrations of these vertex algebras in the case of rational levels.