Vertex Operator Algebras, Number Theory and Related Topics

A Celebration of Geoff Mason's 70th Birthday

Sacramento State University June 11–15 2018

All talks will be in Riverside Hall, Room 1015
Discussion rooms: Sequoia Hall Rooms 128 and 142

Program

Monday June 11

08:30–09:00	**Welcome**
09:00–09:50	*Vertex operator superalgebras*, Chongying Dong (University of California, Santa Cruz)
09:50–10:20	**Break**,
10:20–11:10	*The concept of "motivated proofs" of partition identities - toward the construction of twisted modules for intertwining algebras*, Jim Lepowsky (Rutgers University)
11:10–12:00	*Trace functions for the parafermion vertex operator algebras*, Li Ren (Sichuan University)
12:00–13:30	**Lunch**
13:30–14:20	*Integral forms in vertex operator algebras*, Robert Griess (University of Michigan)
14:20–15:10	*Higher level Zhu algebras and indecomposable modules for vertex operator algebras*, Katrina Barron (University of Notre Dame)
15:10–15:40	**Break**
15:40–16:30	*Lattices and vertex operator algebras*, Gerald Höhn (Kansas State University)
16:30–17:00	*Vector-valued modular forms on* $\Gamma_0(2)$, Richard Gottesman (University of California, Santa Cruz)
17:00–19:00	**Reception at Epicure Restaurant**

Tuesday June 12

08:30–09:20	*Vertex operator algebras generated by Ising vectors of* σ*-type*, Cuipo Jiang (Shangai Jiaotong University)
09:20–10:10	*The truth about finite groups and VOAs*, Terry Gannon (University of Alberta)
10:10–10:40	**Break**
10:40–11:30	*A dimension formula for orbifolds and some applications*, Nils Scheithauer (Technische Universität Darmstadt)
11:30–12:00	*A uniform construction of the holomorphic VOAs of central charge 24 from the Leech lattice VOA*, Sven Möller (Rutgers University)
12:00–13:30	**Lunch**
13:30–14:20	$N = 2$ *minimal models at unitarity and beyond*, Simon Wood (Cardiff University)
14:20–15:10	*Special values of Hecke L-functions of modular forms of half-integral weight and cohomology*, Wissam Raji (American University of Beirut)
15:10–15:40	**Break**
15:40–16:30	*On indecomposable and logarithmic modules for affine vertex operator algebras*, Drazen Adamović (University of Zagreb)
16:30–17:00	*Periods of modular curves and vector-valued modular forms*, Christopher Marks (California State University, Chico)
17:00–17:30	*Modular forms and Jacobians with complex multiplication*, Luca Candelori (University of Hawaii)

Wednesday June 13

08:30–09:20	*The skew-Maass lift*, Olav Richter (University of North Texas)
09:20–10:10	*Actions of Taft Hopf algebras and their doubles on matrices*, Susan Montgomery (University of Southern California)
10:10–10:40	**Break**
10:40–11:30	*Vertex G-algebras and their equivariant quasi modules*, Haisheng Li (Rutgers University)
11:30–12:00	*On the tensor structure of modules for compact orbifold vertex operator algebras*, Robert McRae (Vanderbilt University)
12:00–13:30	**Lunch**
13:30–14:20	*Coefficients of meromorphic Jacobi forms and characters of vertex algebras*, Antun Milas (SUNY-Albany)
14:20–15:10	*Griess subalgebra and modular forms of Siegel type*, Masahiko Miyamoto (University of Tsukuba)
15:10–15:40	**Break**
15:40–16:30	*Coset construction and quantum geometric Langlands program*, Tomoyuki Arakawa (RIMS, Kyoto University)
16:30–17:00	*Permutations orbifolds of the Heisenberg vertex algebra* $\mathcal{H}(3)$, Michael Penn (Randolph College)
18:00–20:00	**Conference Dinner at Evan's Kitchen, near Sacramento State**

Thursday June 14

08:30–09:20	*Modular forms of rational weights and the minimal models*, Kiyokazu Nagatomo (Osaka University)
09:20–10:10	*A new family of braided quasi-Hopf algebras and their representation categories*, Siu-Hung Ng (Louisiana State University)
10:10–10:40	**Break**
10:40–11:30	*An application of nonabelian Hodge theory to the study of vector valued modular forms*, Cameron Franc (University of Saskatchewan)
11:30–12:00	*Genus two Zhu reduction for vertex operator algebras*, Thomas Gilroy (Institute of Technology Tallaght, Dublin)
12:00–13:30	**Lunch**
13:30–14:20	*Leech lattice and holomorphic vertex operator algebras of central charge 24*, Ching Hung Lam (Academia Sinica)
14:20–15:10	*Relaxed modules over affine vertex operator algebras*, David Ridout (University of Melbourne)
15:10–15:40	**Break**
15:40–16:30	*Extended Monstrous Moonshine*, Scott Carnahan (University of Tsukuba)
16:30–17:00	*Moonshine in weight* 3/2, Michael H. Mertens (University of Cologne)
17:00–17:30	*Tensor categories for vertex operator (super)-algebra extensions*, Shashank Vivek Kanade (University of Denver)

Friday June 15

08:30–09:20	*Finite simple groups and number theory*, John Duncan (Emory University)
09:20–10:10	*Modular linear differential equations in general form*, Yuichi Sakai (Kyushu University)
10:10–10:40	**Break**
10:40–11:30	*Conformal embeddings and associated vertex algebras*, Ozren Perše (University of Zagreb)
11:30–12:00	*On the Landau-Ginzburg/conformal field theory correspondence*, Ana Ros Camacho (Utrecht University)
12:00–13:30	**Lunch**
13:30–14:00	*Fusion products for permutation orbifolds*, Nina Yu (Xiamen University)
14:00–14:30	164/5 *and* 236/7, Yusuke Arike (Kagoshima University)
14:30–	**Discussions**

Abstracts

Adamović, Drazen (University of Zagreb)

On indecomposable and logarithmic modules for affine vertex operator algebras

Admissible affine vertex operator algebras $V_k(\mathfrak{g})$ are semi-simple in the category $\mathcal{O}$. In this talk, we shall first present a complete reducibility result for a large class of simple affine vertex operator algebras $V_k(\mathfrak{g})$ at non-admissible levels (joint work with Kac, Moseneder-Frajria, Papi and Perse). Then we shall consider $V_k(\mathfrak{g})$–modules outside of the category $\mathcal{O}$. Logarithmic modules appear in the non-split extension of certain weight modules. Although $V_k(\mathfrak{g})$–modules are modules for the affine Lie algebras, it is difficult to construct indecomposable and logarithmic modules using concepts from the representation theory of Lie algebras. We will show how these modules can be explicitly constructed using vertex-algebraic techniques. We will also show that certain Whittaker modules are also weak $V_k(\mathfrak{g})$–modules.

Arakawa, Tomoyuki (RIMS, Kyoto University)

Coset construction and quantum geometric Langlands program

Coset construction is a well-known method to obtain new vertex algebras from known ones. Recently, Davide Gaiotto had started to give new interpretations of coset construction in terms of 4d gauge theories and the geometric Langlands program. In this talk I will first present my joint work with Thomas Creutzig and Andrew Linshaw that proves a long-standing conjecture on the coset construction of W-algebras. Then I explain the method used in this work also proves a conjecture of Dennis Gaitsgory that is crucially used in the quantum geometric Langlands program.

Arike, Yusuke (Kagoshima University)

164/5 and 236/7

Let V be a vertex operator algebra (VOA) satisfying the conditions: (i) the space of characters of simple modules is contained in the space of solutions of a 3rd order monic modular linear differential equation (MLDE) and (ii) the weight one subspace is trivial. Tuite and Van obtained a list of central charges of such VOAs and found that there is a VOA for each central charge except 164/5 and 236/7. In this talk we express solutions of the MLDEs for central charges 164/5 and 236/7 as polynomials of characters of minimal models. By using this result, we compute global dimensions and show that VOAs with central charges 164/5 and 236/7 satisfying the conditions are not regular. This talk is based on joint work with Kiyokazu Nagatomo and Yuichi Sakai.

Barron, Katrina (University of Notre Dame)

Higher level Zhu algebras and indecomposable modules for vertex operator algebras

We discuss the relationship between indecomposable modules for a vertex operator algebra and indecomposable modules for the associative algebras defined by Dong, Li and Mason generalizing Zhu's associative algebra. In particular, we focus on the case of non simple indecomposable modules.

Candelori, Luca (University of Hawaii)

Modular forms and Jacobians with complex multiplication

In this talk we describe a new method to construct Jacobian varieties with complex multiplication (CM). More precisely, we give a new cohomological criterion to detect CM in modular curves, based on a new algorithm by Chris Marks which computes the period matrix of a modular curve. Since the period matrices of CM Jacobians have algebraic entries, we can compute them exactly without the need of numerical approximation. Our methods are based on the theory of modular forms taking values in the canonical representation of Riemann surfaces with many automorphisms, improving on earlier work of Wolfart. This is all joint work with Chris Marks and several current and past undergraduate students at Chico State.

Scott Carnahan, Scott (University of Tsukuba)

Extended Monstrous Moonshine

Monstrous Moonshine was extended in two complementary directions during the 1980s and 1990s, giving rise to Norton's Generalized Moonshine conjecture and Ryba's Modular Moonshine conjecture. Generalized Moonshine is now interpreted as a statement about orbifold conformal field theory, and Modular moonshine is interpreted as a statement about Tate cohomology of an integral form of the Moonshine module. Both conjectures have been unconditionally resolved in the last few years, so we outline the solutions, and consider some speculative conjectures that may extend and unify them.

Dong, Chongying (University of California, Santa Cruz)
Vertex operator superalgebras

Let $V = V_{\bar{0}} + V_{\bar{1}}$ be a vertex operator superalgebra. Then V has a canonical automorphism σ of order 2 from the super structure. We assume V is rational and C_2-cofinite. We will discuss the super σ-twisted modules, connection between representations of V and $V_{\bar{0}}$. We will also explain how the representation theory of V is related to the 16-fold way conjecture in category theory. This talk is based on joint work with Richard Ng and Li Ren.

Duncan, John (Emory University)
Finite simple groups and number theory

The problem of computing rational solutions to polynomial equations motivates much research in number theory. In this talk we will describe some new forms of moonshine which point toward a special role for distinguished finite groups in this area.

Franc, Cameron (University of Saskatchewan)
An application of nonabelian Hodge theory to the study of vector valued modular forms

It is well-known that it is easier to study modular forms that transform according to a representation of a fundamental group when the representation is unitary. One innovation of the work of Knopp-Mason and their collaborators from the 2000s was the observation that part of the theory of modular forms extends to the nonunitary case. In 1965, Narasimhan-Seshadri showed that irreducible projective unitary representations of fundamental groups correspond to holomorphic vector bundles satisfying a stability condition. This result set off a flurry activity that directed research in the algebraic study of vector bundles for several decades. Carlos Simpson, building on previous work of Hitchin, Donaldson, Corlette, Deligne and many others, discovered the nonabelian Hodge correspondence in the 1980s. This correspondence relaxes the unitary hypothesis of Narasimhan-Seshadri and identifies, categorically, all irreducible projective representations of a fundamental group with stable Higgs bundles, where a Higgs bundle is a holomorphic bundle enhanced with a differential form taking values in endomorphisms of the bundle (the Higgs field). Moduli spaces of Higgs bundles have a tremendous amount of beautiful structure (for example, the Hitchin fibration and a torus action) that has not been incorporated into the study of vector valued modular forms. In this talk we will use uniformization to explain how nonabelian Hodge theory and the study of vector valued modular forms interact. As an application of how one might exploit this interaction, we will explain how nonabelian Hodge theory can be used to prove new cases of a conjecture of Franc-Mason on the decomposition types of vector bundles that arise in the study of vector valued modular forms. This talk reports on joint work with Steve Rayan.

Gannon, Terry (University of Alberta)
The truth about finite groups and VOAs

It has been conjectured that any modular tensor category is the category of modules of a strongly-rational VOA – this is called reconstruction. The first class of categories to consider, where the answer is not clear, is that of the twisted Drinfeld doubles of finite groups G (the twist is a 3-cocycle of G). I'll describe recent work which constructs such a VOA for any solvable G and 3-cocycle ω. The same proof works for any group G (and cocycle ω), provided we know that some holomorphic permutation orbifold by G is strongly-rational. In the process, we identify the 3-cocycle twists of holomorphic permutation orbifolds, as well as the extensions of VOAs whose category of modules is a twisted double of a finite group. This is joint work with David Evans.

Gilroy, Thomas (Institute of Technology Tallaght, Dublin)
Genus two Zhu reduction for vertex operator algebras

We consider formal correlation functions for a vertex operator algebra on a genus two Riemann surface formed by sewing two tori together. We describe a generalisation of genus one Zhu recursion where we express an arbitrary genus two n–point sums in terms of $(n-1)$–point sums. We consider several applications of genus two Zhu Reduction, including the correlation functions for the Heisenberg vertex operator algebra and its modules, Virasoro correlation functions and genus two Ward identities. This is joint work with Michael Tuite.

Gottesman, Richard (University of California, Santa Cruz)
Vector-valued modular forms on $\Gamma_0(2)$

Vector-valued modular forms form a graded module over the ring of modular forms. I will explain how understanding the structure of the module of vector-valued modular forms allows one to show that the component functions of vector-valued modular forms are solutions to certain ordinary differential equations. In certain

cases, one can use a Hauptmodul and hypergeometric series to solve these differential equations. One then obtains the q-series expansions of the vector-valued modular forms. This perspective gives a viable approach towards proving certain cases of the unbounded denominator conjecture.

Griess, Robert (University of Michigan)
Integral forms in vertex operator algebras

An integral form in an algebra is the integral span of a basis which is closed under the product. For an integral form in a vertex operator algebra (VOA), we require closure under the given countably many products, plus a few additional conditions. Reference for VOA theory: Vertex Operator Algebras and the Monster, by Frenkel, Lepowsky, Meurman; see definition p.244. Of particular interest are G-invariant integral forms where G is a finite subgroup of the automorphism group. We mention a subset of recent results on (1) integral forms in lattice type VOA; (2) infinite dimensional graded representations of Chevalley-Steinberg groups (over any commutative ring) on vertex algebras which extend their natural action on the adjoint module; (3) the case of a G-invariant integral form in the Moonshine VOA where G is the full automorphism group, isomorphic to the Monster sporadic simple group; (4) maximal G-invariant integral forms in degree 2 summands of dihedral VOAs.

Höhn, Gerald (Kansas State University)
Lattices and vertex operator algebras

In my talk I will explain how even lattices can be used to describe vertex operator algebras. As an application, I will explain different descriptions of the vertex operator algebras of central charge 24 in the genus of the Moonshine module.

Jiang, Cuipo (Shangai Jiaotong University)
Vertex operator algebras generated by Ising vectors of σ-type

We prove that a simple moonshine type vertex operator algebra generated by Ising vectors of σ-type is uniquely determined by its Griess algebra. With this result, we give characterization of all the simple moonshine type vertex operator algebras generated by Ising vectors of σ-type. In particular, we prove that the moonshine type vertex operator algebra generated by Ising vectors of σ type with the associated 3-transposition group being S_n is simple and isomorphic to the rational vertex operator algebra $C_{L_{\widehat{sl_2}}^{\otimes n}}(L_{\widehat{sl_2}}(n,0))$. We conjecture that all the moonshine type vertex operator algebras generated by Ising vectors of σ-type are simple and rational. This is a joint work with Ching Hung Lam and Hiroshi Yamauchi.

Kanade, Shashank Vivek (University of Denver)
Tensor categories for vertex operator (super)-algebra extensions

Let V be a vertex operator algebra along with a suitable vertex tensor category of modules, $\mathcal{C}$. Huang-Kirillov-Lepowsky showed that algebra objects A in $\mathcal{C}$ are precisely conformal embeddings $V \hookrightarrow A$. Moreover, for any such algebra object A, its category of "dyslectic" (also known as "local") modules is equivalent, as an abelian category, to the category of modules of A viewed as a vertex operator algebra. I will present the main theorem of a joint work with T. Creutzig and R. McRae which states that this equivalence is in fact an equivalence of braided monoidal categories. Here, the tensor structure on the dyslectic modules is given by Pareigis and Kirillov-Ostrik and the one on the vertex algebra side is as given by Huang-Lepowsky-Zhang. There are many handy consequences, for instance, one obtains a monoidal induction functor for such conformal embeddings. With appropriate changes, all of these theorems hold when A is in fact a vertex operator superalgebra.

Lam, Ching Hung (Academia Sinica)
Leech lattice and holomorphic vertex operator algebras of central charge 24

Recently, G. Höhn proposed a uniform construction of all 71 holomorphic VOAs in Schellekens' list using certain orbifold VOAs associated with some coinvariant lattices of the Leech lattice. In this talk, we will discuss his idea and prove one of his conjectures, namely, all irreducible modules for the orbifold VOA $V_{\Lambda_g}^{\hat{g}}$ are simple current modules, where Λ = Leech lattice and Λ_g denotes the coinvariant of g in Λ. We also determine the correspondence quadratic space structure for the fusion group $R(V_{\Lambda_g}^{\hat{g}})$. As an example, we will describe a construction of a holomorphic VOA of central charge 24 such that its weight one Lie algebra has the type $F_{4,6}A_{2,2}$ using Höhn's idea.

Lepowsky, Jim (Rutgers University)
The concept of "motivated proofs" of partition identities - toward the construction of twisted modules for intertwining algebras

Z-algebras (Lepowsky, Wilson, Primc), were constructed for the purpose of interpreting and proving generalized Rogers-Ramanujan identities by means of combinatorial bases of modules. These algebras eventually came to be understood as the low-conformal-weight natural generating substructures of twisted and untwisted modules for certain generalized vertex operator algebras in the sense of Dong-Lepowsky, and in fact they helped motivate the development of vertex operator algebra theory in general. Z-algebras operate on one module at a time, but some of the most interesting classical proofs of Rogers-Ramanujan-type identities combine identities in families. This fact has led to developments in vertex-algebraic intertwining algebra theory. A notion of "motivated proofs" of such identities, initially stimulated by a proof of Rogers-Ramanujan and Andrews-Baxter, is influencing the developing theory of twisted modules for intertwining algebras. With only relatively few remarkable exceptions, the identities that have been interpreted so far in terms of vertex operator algebra theory have typically been of a relatively "classical" type, and it is hoped that this barrier can be broken by means of an appropriate general module theory. This work includes joint work with C. Calinescu, S. Capparelli, B. Coulson, S. Kanade, R. McRae, A. Milas, F. Qi, M. Russell, C. Sadowski, A. Sills and M. Zhu.

Li, Haisheng (Rutgers University)
Vertex G-algebras and their equivariant quasi modules

In this talk, we shall first review the theory of vertex G-algebras and their equivariant quasi modules, and we then give a canonical connection of certain q-Heisenberg Lie algebras and trigonometric Lie algebras with vertex G-algebras and their equivariant quasi modules.

Marks, Christopher (California State University, Chico)
Periods of modular curves and vector-valued modular forms

I will explain how vector-valued modular forms may be used to compute explicitly periods of modular curves, for both congruence and noncongruence subgroups of the modular group. This is ongoing research with Luca Candelori, who will explain in his talk how the above method sheds new light on Jacobian varieties with complex multiplication.

McRae, Robert (Vanderbilt University)
On the tensor structure of modules for compact orbifold vertex operator algebras

Suppose V^G is the fixed-point vertex operator subalgebra of a compact group G acting on a simple vertex operator algebra V. By a theorem of Dong, Li, and Mason, V is semisimple as a module for G and V^G; in particular $V = \bigoplus_{\chi \in \widehat{G}} M_\chi \otimes V_\chi$, where the sum runs over all irreducible finite-dimensional continuous characters of G, M_χ is the corresponding finite-dimensional G-module, and the V_χ are (non-zero) distinct irreducible V^G-modules. In this talk, we show that if $\mathcal{C}$ is any vertex braided tensor category of V^G-modules that includes all V_χ, then there is a tensor functor $\Phi : \mathrm{Rep}\ G \to \mathcal{C}$ for which $\Phi(M_\chi^*) \cong V_\chi$. In particular, Φ is an equivalence of symmetric tensor categories between Rep G and the tensor subcategory of $\mathcal{C}$ generated by the V_χ. The only assumption needed for this result is the existence of the braided tensor category $\mathcal{C}$, and in fact we show the existence of a suitable $\mathcal{C}$ if it is already known that the fusion rules among the V_χ agree with the dimensions of spaces of intertwiners among finite-dimensional G-modules. As an application, we show that the Virasoro vertex operator algebra at central charge $c = 1$ has a symmetric tensor category of modules equivalent to Rep $SO(3)$, and a larger braided tensor category of modules closely related to Rep $SU(2)$.

Mertens, Michael H. (University of Cologne)
Moonshine in weight $3/2$

For most known instances of Moonshine, the corresponding McKay-Thompson series are modular forms (in some sense) of weight 0 or $1/2$. Recently, a new type of Moonshine, which involves weight $3/2$ modular forms, has been discovered, which, as one of its features, concerns the non-monstrous sporadic O'Nan group. In my talk, I will discuss this phenomenon and, time permitting some more recent work in progress on other possible instances of weight $3/2$ moonshine.

Milas, Antun (SUNY-Albany)
Coefficients of meromorphic Jacobi forms and characters of vertex algebras

Jacobi forms are of central interest in representation theory of affine Kac-Moody Lie algebras, affine Lie superalgebras, Moonshine, etc. Their Fourier coefficients have been studied from several different perspective. For instance, it is known that in many cases "canonical" Fourier coefficients can be completed to obtain (almost) harmonic Maass forms. In my talk we will discuss coefficients of meromorphic Jacobi forms coming from several different sources: quantum modular forms, representations of the affine Lie algebra sl_n at level -1 and extensions thereof. This talk is based on several ongoing collaborations with K. Bringmann, J. Kaszian, with K. Mahlburg, and with D. Adamovic.

Miyamoto, Masahiko (University of Tsukuba)
Griess subalgebra and modular forms of Siegel type

In our paper with Krauel, we treated each theta function as a factor of trace functions defined by Griess subalgebras isomorphic to Siegel space on two VOAs and then we proved the modular invariance property of Siegel type. In this talk, I will show you another example of such multivariable modular form.

Möller, Sven (Rutgers University)
A uniform construction of the holomorphic VOAs of central charge 24 from the Leech lattice VOA

The classification of strongly rational, holomorphic VOAs of central charge 24 is now established if the weight-one space is non-trivial. Conjecturally the only case with vanishing weight-one space is the Moonshine module. We describe a uniform construction of these 71 VOAs (called Schellekens' list) as cyclic orbifold constructions from the Leech lattice VOA. Our construction is analogous to the construction of the Niemeier lattices from the deep holes of the Leech lattice. (This is joint work with Nils Scheithauer.)

Montgomery, Susan (University of Southern California)
Actions of Taft Hopf algebras and their doubles on matrices

We determine all possible actions of the n^2 dimensional Taft algebra $H(n)$ on $n \times n$ matrices over $\mathbb{C}$. This is an old problem, as determining $D(H)$-modules helps determine the Hopf Brauer group for H. This was done for the case $n = 2$ about 2000 by Van Oystaeyen and Y. Zhang, although their proof depended heavily on the fact that $H(2)$ is quasi-triangular, which is false for $n > 2$. More recently Etingof and Walton have looked at actions of $H(n)$ on a domain. Our methods are very different and use recent work on classification of group gradings of matrices. This is joint work with Yuri Bakhturin.

Nagatomo, Kiyokazu (Osaka University)
Modular forms of rational weights and the minimal models

T. Ibukiyama discovered the modular forms of rational weights with some multipliers on $\Gamma(5)$ (and $\Gamma(7)$) and then formulated modular forms of weights $(N-3)/2N$ ($N > 3$ and odd) on $\Gamma(N)$ in the millennium, which have remained mysterious until now because the multipliers are very complicated. In this talk I will gives a vertex operator algebra point of view, which has advantages of understanding the factional weights, congruence groups and multipliers, which appear in the theory of Ibukiyama. I (and Sakai) have been working on the minimal models and the associated modular linear differential equations which are higher order generalization of Kaneko-Zagier equation. Recently, we found that the special case of the minimal models "essentially" gives these modular forms of fractional weights, where "essentially" means "after multiplying a power of the Dedekind eta function." The characters (one-point functions) of (rational) conformal field theories may have negative powers of $q = e^{2\pi i\tau}$ when they are expanded as Fourier series. Of course, we can have remove negative powers by multiplying a power of q. However, the result loses almost all *nice* properties which characters have (including modular invariance property). Now, since the eta function commutes with the Serre derivation, we multiply a power of the eta function to the characters. What now clear is that the power must be the so-called *effective central charge* in the Physics literature. Then the result we will prove is that modular forms of rational weights are obtained by multiplying $\eta^{c_{\text{eff}}}$ to characters of minimal models. Moreover, the multipliers are nothing but that of a power of eta function. In a differential equation point of view, *special functions* would be defined as solutions of differential equations with regular singularities. Therefore we may think that modular forms of rational weights could be "special functions." This talk requires elementary knowledges of (modular forms), minimal models and modular linear differential differential equations. Finally, this is a joint work with Y. Sakai (who is a number theorist) at Kyushu University.

Ng, Siu-Hung (Louisiana State University)
A new family of braided quasi-Hopf algebras and their representation categories

The construction of twisted quantum doubles of finite groups G was motivated by holomorphic orbifolds in conformal field theory. One would expect a generalization for the orbifolds of rational VOAs whose irreducible modules are simple currents. In this talk, we present a generalized construction of braided quasi-Hopf algebras $D^\omega(G, A)$ from a central subgroup A and a 3-cocycle ω of G. The modularity of their representation categories is equivalent to the nondegeneracy of some bicharacter induced on A. We particularly consider some finite groups with a unique involution as examples. This talk is based on some joint works with Geoffrey Mason.

Penn, Michael (Randolph College)
Permutations orbifolds of the Heisenberg vertex algebra $\mathcal{H}(3)$

We adapt the theory of polynomial invariants of finite groups to study the S_3-orbifold of a rank three Heisenberg vertex algebra in terms of generators and relations. In particular, we prove that the orbifold algebra has a minimal strongly generating set of vectors whose conformal weights are $1, 2, 3, 4, 5, 6^2$ (two generators of degree 6). We also study modular properties of characters of modules for this vertex algebra. We also discuss similar orbifolds of fermion and symplectic fermion vertex algebras.

Perše, Ozren (University of Zagreb)
Conformal embeddings and associated vertex algebras

In this talk we will review some recent results on conformal embeddings of affine vertex algebras, obtained in joint works with D. Adamovic, V. G. Kac, P. Moseneder Frajria and P. Papi. It turns out that in many examples of conformal embeddings, the structure theory and representation theory of associated vertex algebras is not very well understood so far. Such cases include affine vertex algebras of negative integer level. A particular emphasis of the talk will be given on the understanding of properties of such vertex algebras.

Raji, Wissam (American University of Beirut)
Special values of Hecke L-functions of modular forms of half-integral weight and cohomology

The famous Eichler-Shimura theorem states that two copies of the space of cusp forms of integer weight k for the full modular group are isomorphic to the cohomology group of periods. The theory of Eichler-Shimura plays an important role in the theory of integral weight modular forms, connecting e.g. to elliptic curves, critical values of L-functions and Hecke operators. We start developing a cohomology theory in the case of half-integral weight with an attempt to focus again on the connection to special values of $L(f, s)$ at half-integral and integral points inside the "critical strip", similar as in the case of integral weight. (with Winfried Kohnen)

Ren, Li (Sichuan University)
Trace functions for the parafermion vertex operator algebras

We will discuss how to use the trace functions for the affine vertex operator algebras and lattice vertex operator algebras to study the trace functions for the parafermion vertex operator algebras.

Richter, Olav (University of North Texas)
The skew-Maass lift

I will present ongoing joint work with O. Imamoglu and M. Raum. The classical Maass lift is a map from holomorphic Jacobi forms to holomorphic scalar-valued Siegel modular forms. Automorphic representation theory predicts a non-holomorphic and vector-valued analogue, which we will construct in this talk. Specifically, we lift skew-holomorphic Jacobi forms to certain real-analytic, vector-valued Siegel modular forms. As a by-product, we give a complete answer to Kohnen's question on the connection between skew-holomorphic Jacobi forms and real-analytic Siegel modular forms.

Ridout, David (University of Melbourne)
Relaxed modules over affine vertex operator algebras

Some of the most important non-rational VOAs are the admissible level affine ones. Arakawa has classified their simple modules in category O. Motivated by modularity and consistency, we instead ask for a classification of simple modules in category R, the category of "relaxed" highest-weight modules. Our results will be illustrated with the admissible level VOAs associated to sl_2 and, if time permits, $osp(1|2)$ and sl_3.

Ros Camacho, Ana (Utrecht University)
On the Landau-Ginzburg/conformal field theory correspondence

In this talk we will introduce the Landau-Ginzburg/conformal field theory correspondence, a result from the physics literature of the late 80s and early 90s. In particular it predicts some relation between categories of matrix factorizations and categories of representations of vertex operator algebras. Unfortunately, to date we lack a precise mathematical statement for it. We will review some recent examples of this correspondence and some work in progress. Joint work with I. Runkel, A. Davydov, et al.

Sakai, Yuichi (Kyushu University)
Modular linear differential equations in general form

It is well known that modular linear differential equations(MLDEs) appear as tools in studies related to supersingular elliptic curves and classifications of characters of vertex operator algebras(VOAs). In some cases, MLDEs give a certain correspondence between modular forms and characters of VOAs. Therefore MLDEs are useful tools. In this talk, we determine the properties of coefficients of MLDEs of any order by using the definition of MLDEs only. Furthermore, we give a general expression of MLDEs under the natural assumption for non-compact (quasi)modular forms.

Scheithauer, Nils (Technische Universität Darmstadt)
A dimension formula for orbifolds and some applications

We derive a dimension formula for orbifolds of holomorphic vertex operator algebras and describe some applications. (This is joint work with S. Möller).

Wood, Simon (Cardiff University)
$N = 2$ minimal models at unitarity and beyond

$N = 2$ minimal model vertex operator superalgebras are the simple quotients of the universal $N = 2$ superconformal vertex operator superalgebras at central charges where they are not simple. These minimal models are rational if and only if they are unitary, so unsurprisingly, the unitary cases are well studied while the remainder are not. In this talk I will review the representation theory of (not necessarily unitary) minimal models and present new results on fusion at the level of the Grothendieck ring.

Yu, Nina (Xiamen University)
Fusion products for permutation orbifolds

The permutation orbifolds study the action of permutation groups on the tensor products of vertex operator algebras. This talk will report our recent progress on the fusion products of twisted modules for general permutation orbifolds. The motivation is to understand the module categories for the fixed point vertex operator subalgebras under the permutation groups. This is a joint work with Chongying Dong and Feng Xu.

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