REPRESENTATION THEORY XV

Dubrovnik, Croatia, June 18-25, 2017

ABSTRACTS OF TALKS

Finite Dimensional Representations

Jeffrey Adams, University of Maryland

The main objects of study of the Atlas of Lie Groups and Representations are infinite dimensional representations. However there are quite a few interesting open questions about finite dimensional representations. One is: what can one say about the signature of the invariant (Hermitian or bilinear) form on an irreducible finite dimensional representation? How does this depend on the real form of the group? Another one is: if $g \in G$ represents the Coxeter element of the Weyl group, its trace in any finite dimensional representation is $0, \pm 1$ (Kostant). What do these values mean, and are there other conjugacy classes like this?

Q-systems and Generalizations in Representation Theory

Darlayne Ann Addabbo, University of Illinois

In this talk, we will define tau-functions given as matrix elements for the action of $\widehat{GL_n}$ on n-component fermionic Fock space. In the $n = 2$ case, these tau-functions are equal to Hankel determinants, and applying the famous Desnanot-Jacobi identity, we can see that they are solutions to a Q-system. Q-systems are of interest in many areas of mathematics, for example in representation theory and in combinatorics, so it is natural to expect that the systems of equations satisfied by the $n > 2$ tau-functions are also interesting. Here, we will primarily discuss the $n = 3$ case.

We have generalized this work by considering tau-functions given as matrix elements for the action of infinite matrix groups on n-component fermionic Fock space. In the $n = 2$ case, our tau-functions are solutions to a T-system, which is a generalization of the Q-system obtained in the $\widehat{GL_2}$ case. It is known that the Q-system (with some extra conditions) can be ultra-discretized to obtain the Box and Ball system. The second half of this talk will include a discussion of a generalized Box and Ball system obtained from ultra-discretizing the T-system.

(Joint work with Maarten Bergvelt.)

The CKP and DKP hierarchies and their bosonizations

Iana Angelova, College of Charleston

The BKP and CKP hierarchies were introduced by Date, Jimbo, Kashiwara and Miwa as reductions of the KP hierarchy, with DKP hierarchy related to the BKP. In this talk I will discuss the bosonizations of these hierarchies (bosonization refers to the representation of given chiral fields/vertex operators via exponentiated boson fields/lattice vertex operators). Although the bosonization of the BKP hierarchy has been known for some time, this is not the case for the CKP and DKP hierarchies. In particular, surprisingly there are not one, but two different bosonizations of the CKP hierarchy: one via a twisted Heisenberg algebra, and the second via untwisted Heisenberg algebra. We will discuss some applications related to these bosonizations, and also the issue of solutions to these hierarchies.

Moore-Tachikawa conjecture and vertex algebras

Tomoyuki Arakawa, RIMS, Kyoto University/MIT

Motivated by the string theory, Moore and Tachikawa conjectured in 2011 the existence of two-dimensional topological quantum field theories whose values are holomorphic symplectic varieties. In my talk I will reduce the Moore-Tachikawa conjecture to a conjecture on vertex algebras.

P-adic Banach space representations and Iwasawa modules

Dubravka Ban, Southern Illinois University

We use the duality theory of Schneider and Teitelbaum between admissible Banach space representations and finitely generated modules over Iwasawa algebras to study continuous principal series representations. We discuss reducibility and some other basic properties. This is a joint work with Joe Hundley.

Representations of the periplectic Lie superalgebra $\mathfrak{p}(n)$

Martina Balagović, Newcastle

We study the category of finite dimensional representations of the strange periplectic Lie superalgebra $\mathfrak{p}(n)$, using combinatorial tools and links to certain diagram algebras. This is work in progress, joint with Z. Daugherty, I.Entova-Aizenbud, I.Halacheva, J.Hennig, M.S.Im, G.Letzter, E.Norton, V.Serganova, and C.Stroppel.

Unipotent Representations and nilpotent orbits

Dan Barbasch, Cornell University

Motivated by the philosophy of the orbit method, we investigate the relationship between the $K-$structure of the unipotent representations and the rings of regular sections of equivariant bundles of nilpotent orbits. Such relations were detailed in previous talks for the classical complex groups. In this talk we will concentrate on small rank representations for real groups, In particular we will make explicit relations to model orbits. The case of E_8 is joint with H.-Y. Loke, and the other cases for nonlinear covers are joint with W.-Y. Tsai.

Higher level Zhu's algebras and indecomposable modules for vertex operator algebras

Katarina Barron, University of Notre Dame

We study the relationship between modules for higher level Zhu's algebras for a vertex operator algebra V at level n and modules for Zhu's algebra for V at level $n-1$, for a positive integer n. We then discuss the relationship between modules for higher level Zhu's algebras and indecomposable modules for V, providing some illustrative examples.

Combinatorial bases of principal subspaces for affine Lie algebras

Marijana Butorac, University of Rijeka, Croatia

Principal subspaces of standard modules for untwisted affine Lie algebras were introduced by Feigin and Stoyanovsky, and have been further studied by many other authors. In this talk, we introduce and discuss combinatorial bases of principal subspaces of certain standard modules and their fermionic characters. This talk is based on joint work with Mirko Primc.

The rigid cocenter of a reductive p-adic group

Dan Ciubotaru, Oxford

In this talk, I will explain the notion of rigid cocenter of the Hecke algebra of a reductive p-adic group and its relation with the Grothendieck group of smooth admissible representations, in particular, the trace Paley-Wiener theorem. For an associative algebra, the cocenter is the quotient space by the linear subspace of commutators. For p-adic groups, the study of the cocenter goes back to the well-known work of Bernstein, Deligne, and Kazhdan. The present work, joint with Xuhua He, is partly motivated by an effort to extend the classical results for complex representations to modular representations of p-adic groups, which requires a more detailed analysis of the cocenter.

The affine vertex superalgebra of $D(2,1;\alpha)$ as master chiral algebra for $SU(2)$

Thomas Creutzig, University of Alberta

Four-dimensional supersymmetric gauge theory as well as the quantum geometric Langlands correspondence expect the existence of a "master VOA" that somehow explains correspondences of braided tensor categories/spaces of conformal blocks.

I want to explain our understanding of two of the predictions of this physics/geometry picture and how the affine vertex operator superalgebra of $D(2,1;\alpha)$ at level one is central in this story in the $sl(2)$-case. Firstly, Weyl modules of the affine vertex algebra of $sl(2)$ are obtained as a certain quantum Hamiltonian reduction of certain modules of $D(2,1;\alpha)$ at level one and secondly there are equivalences of certain braided tensor subcategories of the affine VOA of $sl(2)$ and the Virasoro vertex algebra.

This is joint work in progress with Davide Gaiotto.

Finite dimensional modules for rational Cherednik algebras

Marcelo De Martino, Oxford

We aim to construct some finite dimensional simple modules for rational Cherednik algebras with t=1. In our construction, we define an analog of the so-called integral-reflection representation that was studied by Emsiz-Opdam-Stokman and by Ciubotaru-Opdam-Trapa. Using this representation, we construct a Dirac operator in which we expect to realise the finite dimensional simple modules in its kernel. We discuss the rank one case and some other examples. This is a joint-work (in progress) with D. Ciubotaru.

Module categories associated to vertex operator superalgebras

Chongying Dong, Santa Cruz

This talk will discuss module categories associated to vertex operator superalgebras and their connection to the 16-fold way conjecture in category theory. The is a joint work with Richard Ng and Li Ren.

Rank for representations of classical groups

Roger Howe, Yale

This talk will explain how the concept of rank, introduced in the 1980s for unitary representations of classical groups over local fields, can be extended to admissible representations, and also applied to representations of groups over finite fields. In this more general form, the notion of rank provides an organizing structure for representations of these groups.

Symplectic Dirac cohomology and lifting of characters

Jing-Song Huang, The Hong Kong University of Science and Technology

A fundamental principle in representation theory and Langlands program is that of lifting or transfer of representations between reductive groups. We discuss the lifting of characters in Howe duality between special orthogonal group $SO(2n+1)$ and the metaplectic covering group $Mp(2n,R)$ in connection with the quantum correspondence and symplectic Dirac cohomology for the Lie superalgebra $osp(1|2n)$. This is closely related to endoscopy, theta correspondence as well as transfer of orbital integrals, and is an important example of Langlands duality of root system of type B_n and C_n.

Tensor product decompositions via Demazure flags

Dijana Jakelić, Willmington

We discuss a relation between two multiplicity problems for representations of an affine Kac-Moody algebra: one of computing outer multiplicities in tensor products of two integrable irreducible modules and the other of computing multiplicities in Demazure flags of a given Demazure module. We express the former in terms of the latter when the underlying simple Lie algebra is simply laced. As a byproduct, we obtain interesting partition identities by combining our result with existing answers to each of the two problems for $\hat{\mathfrak{sl}}_2$. This is a joint work with A. Moura.

Hopf algebra structure for quantum toroidal algebras

Naihuan Jing, North Carolina State University

Quantum toroidal algebras are generalization of quantum affine algebras, ie, certain deformation of the central extension of the toroidal algebra of maps from $C[s, t, s^{-1}, t^{-1}]$ to a simple Lie algebra. Drinfeld has defined a second Hopf algebra structure for the completion of the quantum affine algebra, which can be generalized to the completion of the quantum toroidal algebra. I will discuss the recent development to show that the quantum toroidal algebra has a finite Hopf algebra structure. We also derived the comultiplication formula for the Drinfeld generators of the quantum toroidal algebra in the type A (joint work with Honglian Zhang).

An introduction to special cases of Krichever-Novikov algebra

Elizabeth Jurisich, College of Charleston

The three-point algebra is perhaps the simplest nontrivial example of a Krichever-Novikov algebra beyond an affine Kac-Moody algebra. Even though the three-point algebras are not graded by root lattices, nor are they $\mathbb{Z}$–graded, they can be given a coordinatization. This coordinatization allows a generalization of field or vertex operator type representations to be constructed. We provide a natural free field realizations in terms of a beta-gamma system and the oscillator algebra of the three-point an affine Lie algebra when $\mathfrak{g} = sl(2, \mathbb{C})$. In addition, one can construct central extensions of an N-point generalization of the Witt algebra, and a corresponding representation on the Fock space. (Joint with Ben Cox and Renato Martins)

Representations of affine Lie (super)algebras and (mock)theta functions, false and quasi theta functions

Victor Kac, MIT

I will review some old and new results and conjectures on charaters of affine Lie (super)algebras. The official part of the talk will be concluded with a surprize.

Central elements of some quantum vertex algebras

Slaven Kožić, Zagreb

We will consider the vacuum module $\mathcal{V}_c(\mathfrak{gl}_N)$ at the level $c \in \mathbb{C}$ over the double Yangian $\mathrm{DY}(\mathfrak{gl}_N)$. By the results of P. Etingof and D. Kazhdan, $\mathcal{V}_c(\mathfrak{gl}_N)$ has a quantum vertex algebra structure. We will present the explicit description of the center of the quantum vertex algebra $\mathcal{V}_c(\mathfrak{gl}_N)$ and discuss its further applications. This is a joint work with N. Jing, A. Molev and F. Yang.

Reverse orbifold and uniqueness of holomorphic VOA of central charge 24

Ching Hung Lam, Taipei

In this talk, we will give a brief survey on the recent process toward the classification of holomorphic vertex operator algebras of central charge 24. In particular, we will discuss a general strategy for proving the uniqueness of holomorphic vertex operator algebras of central charge 24 with $V_1 \neq 0$ based on orbifold construction and its "reverse" process.

ϕ-coordinated modules for quantum vertex algebras

Haisheng Li, Rutgers University, Camden

This talk is about a certain theory of ϕ-coordinated modules for quantum vertex algebras and its application to associate quantum vertex algebras to certain associative algebras. We shall first review the basic definitions and results on quantum vertex algebras and their modules and ϕ-coordinated modules, and then show how to associate quantum vertex algebras to deformed Virasoro algebras through ϕ-coordinated modules.

Coincidences among $\mathcal{W}$–algebras

Andrew Linshaw, University of Denver

In recent work of Arakawa, Lam, and Yamada, it was shown that the simple parafermion algebra of sl_2 at positive integer level k is isomorphic to a principal, rational $\mathcal{W}$-algebra of sl_k. Similarly, in joint work with Arakawa and Creutzig, we showed that the coset of the Heisenberg algebra inside the rational Bershadsky-Polyakov algebra at level $p/2-3$ for $p = 5, 7, 9, \dots,$ is a principal, rational W-algebra of sl_{p-3}. Several other families of such coincidences were conjectured in a joint work with Arakawa, Creutzig and Kawasetsu. In this talk, I will outline a unified framework that explains all these coincidences, and I will conjecture a number of other coincidences of this kind.

Strongly Homotopy Chiral Algebroids

Fedor Malikov, UCSC

Attached to a finitely generated commutative ring is a family of twisted algebras of differential operators, objects that proved fundamental in various problems of representation theory and mathematical foundations of conformal field theory. These algebras are conveniently described by means of Picard-Lie algebroids, which are appropriate extensions of the Lie algebra of derivations of the original ring.

If the original ring is replaced with its jet algebra, then there arise the corresponding chiral/vertex algebra analogues. In this talk we shall explain how parts of this story can spelled out in the case where the original ring is a differential graded algebra. We will introduce the concepts of strongly homotopy Lie* algebras, Lie* algebroids and chiral algebroids, and classify the latter by means of a truncated Illusie-Chevalley-De Rham complex. These results may be of interest in the case of ordinary Picard-Lie algebroids too.

A generalization of orthogonality relations

Dragan Miličić, University of Utah

We will discuss a generalization of Harish-Chandra's character orthogonality relations for discrete series to arbitrary Harish-Chandra modules for real reductive Lie groups. This result is an analogue of a conjecture by Kazhdan for p-adic reductive groups proved by Bezrukavnikov, and Schneider and Stuhler.

This is a joint work with Jing-Song Huang and Binyong Sun.

Loop Grassmannians

Ivan Mirković, Amherst

Loop Grassmannains are algebro geometric objects associated to reductive groups, of interest in representation theory and quantum field theory. We will consider certain versions of loop Grassmannians motivated by Poincare duality in algebraic geometry.

Affine geometri crystal of $A_n^{(1)}$ and limit of Kirrilov-Reshetikhin Perfect crystals

Kailash C. Misra, North Carolina State University

Let g be an affine Lie algebra with index set $I = \{0, 1, 2, \cdots, n\}$ and g^L be its Langlands dual. It is conjectured in 2008 that for each $k \in I \setminus \{0\}$ the affine Lie algebra g has a positive geometric crystal whose ultra-discretization is isomorphic to the limit of certain coherent family of perfect crystals for g^L. Motivated by this conjecture we construct a positive geometric crystal for the affine Lie algebra $g = A_n^{(1)}$ for each Dynkin index $k \in I \setminus \{0\}$ and show that its ultra-discretization is isomorphic to the limit of a coherent family of perfect crystals for $A_n^{(1)}$. In the process we develop and use some lattice-path combinatorics. This work is joint with T. Nakashima.

Twelfth Night, (Central charge 6)

Masahiko Miyamoto, University of Tsukuba

In connection with Mathieu moonshine phenomenon, M.C.N.Cheng, X.Dong, J.F.R.Duncan, S.Harrison, S.Kachru and T.Wrase have constructed G-invariant $N = 4$ super conformal algebras with central charge 12 for several proper subgroups G of the largest Conway group $Co.0$ by using a lattice SVOA $V_{D_{12}^+}$. Since the original conjecture proposed by T.Eguchi, H.Ooguri and Y.Tachikawa is about a relation between a super conformal algebra with central charge 6 and the largest Mathieu group M_{24}, we study the orbifold thoery $(V_{D_{12}})^{M_{24}}$ and show some M_{24}-invariant actions of totally central charge 6.

Mishchenko-Fomenko algebras and nilpotent bicone

Anne Moreau, University of Lille

Let $\mathfrak{g}$ be a complex semisimple algebra. We consider the Mishchenko-Fomenko subalgebra at a regular element x. It is a maximal Poisson-commutative subalgebra of the symmetric algebra of $\mathfrak{g}$, constructed by the so-called argument shift method. Moreover, it is a polynomial algebra. We show that the free generators of this algebra form a regular sequence. This generalizes a result of Ovsiensko (for $\mathfrak{g} = \mathfrak{sl}_n$ and x semisimple regular). Our proof is related to geometrical properties of the nilpotent bicone. In this talk, I will explain this result and discuss some open questions.

Singular BGG complexes for the symplectic case

Rafael Mrđen, Zagreb

We use Penrose transform to construct certain invariant differential operators attached to Hermitian symmetric pair of type C. These operators fit into exact sequences which are analogues of BGG resolutions in singular infinitesimal character. By a well known duality between invariant differential operators and homomorphisms of generalized Verma modules, our constructed operators correspond to non-standard homomorphisms.

Integral kernel operators for degenerate principal series

Kyo Nishiyama, AGU, Japan

Let $G = U(n, n)$ or $Sp_{2n}(R)$ and P a maximal parabolic subgroup stabilizing a Lagrangian subspace (Siegel parabolic subgroup). Let L be a Levi subgroup which stabilizes a polar decomposition associated with the Lagrangian subspace and choose a parabolic subgroup $Q \subset L$.

We are interested in the geometry of a real double flag variety $X = G/P_S \times L/Q$, on which L acts diagonally, and the representation theory related to X.

In this talk, we introduce integral kernel operators which intertwine degenerate principal series of G and L. For the kernel of the operator, we use relative invariants associated with a prehomogeneous vector space naturally arising from the geometry of X. The integrals have complex parameters, and we determine the region in which they actually converge to define intertwiners of Hilbert space representations. We will also discuss the analytic continuation of the integral operators.

The talk is based on joint work with Bent Ørsted and Akihito Wachi.

Homomorphisms of Verma modules and small representations

Bent Ørsted, University of Aarhus

One possible way to construct representations of a semi-simple Lie group G is to consider solutions to differential equations in spaces of sections of a vector bundle over a flag manifold G/P. Using a well-known duality with homomorphisms of Verma modules, we shall study some examples using BGG sequences, in particular we shall study small unitary representations for some split groups. This is based on joint work with T. Kubo.

Conformal embeddings of affine algebras

Paolo Papi, Rome

Let $\mathfrak{g}$ be a semisimple finite-dimensional complex Lie algebra and $\mathfrak{k}$ a quadratic reductive subalgebra of $\mathfrak{g}$. The pair $(\mathfrak{k}, \mathfrak{g})$ is said to be conformal if there exists a level 1 integrable module for the affinzation of $\mathfrak{g}$ which has finite decomposition w.r.t. the affinization of $\mathfrak{k}$. After discussing some relationships with finite dimensional representation theory, I will introduce a generalization of the above notion to the case of affine vertex algebras. Then I will describe the classification (obtained jointly with Adamović, Kac, Moseneder, Perše) of maximal conformal embeddings of the vertex subalgebra generated by $\{x_{(-1)}|o\rangle \mid x \in \mathfrak{k}\}$ in the simple affine vertex algebras $V_k(\mathfrak{g})$.

Conformal embeddings and associated vertex algebras

Ozren Perše, Zagreb

In this talk we will study some vertex algebraic aspects of conformal embeddings of affine vertex algebras. 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. This talk is based on joint papers with D. Adamović, V. G. Kac, P. Möseneder Frajria and P. Papi.

Modular framed vertex operator algebras

Li Ren, Sichuan University, China

The study of framed vertex operator algebras over the field $\mathbb{C}$ of complex numbers was initiated by Miyamoto, Dong-Griess-Hoehn. The theory of framed vertex operator algebra is based on the representation theory of the Virasoro algebra with central charge 1/2. Framed vertex operator algebras which form an important class of rational vertex operator algebras have played important rules in understanding the uniqueness of the moonshine vertex operator algebra constructed by Frenkel-Lepowsky-Meurman and in classification of holomorphic vertex operator algebras with cental charge 24. In this talk, I will explain how to extend the theory of framed vertex operator algebra from $\mathbb{C}$ to any algebraically closed field $\mathbb{F}$ whose characteristic is different from 2 and 7. In particular, we can obtain a framed vertex operator algebra over $\mathbb{F}$ from any framed vertex operator algebra over $\mathbb{C}$ by constructing a $\mathbb{Z}[1/2]$-form. This is a joint work with Ching Hung Lam and Chongying Dong.

Construction of intertwining operators and logarithmic modules for Heisenberg-Virasoro vertex algebra at level zero and $W(2,2)$-algebra

Gordan Radobolja, Split

We recall our recent result on fusion rules and the representation theory of the Heisenberg-Virasoro vertex algebra at level zero (arXiv:1405.1707; arXiv 1703.00531). We present fusion rules and explicitly realize corresponding intertwining operators for irreducible highest weight modules which are not Verma. We also present a realization of interesting family of logarithmic modules. In the end we discuss some applications to the vertex algebra $W(2,2)$ which is realized as subalgebra of the Heisenberg-Virasoro vertex algebra at level zero. (This is a joint work with D. Adamović).

Formality for the nilpotent cone and the generalized Springer correspondence

Laura Rider, University of Georgia

The Springer correspondence attaches to each irreducible representation of the Weyl group some geometric information (in the form of perverse sheaves) from the nilpotent cone. In my talk, I'll give a brief introduction to the Springer correspondence, and then explain mixed/derived versions of the correspondence. As time allows, I'll also discuss Lusztig's generalized Springer correspondence and recent progress towards mixed/derived versions of the generalized Springer correspondence.

Computing the Lusztig–Vogan Bijection

David Rush, MIT

Let G be a connected complex reductive algebraic group with Lie algebra $\mathfrak{g}$. The Lusztig–Vogan bijection relates two bases for the bounded derived category of G-equivariant coherent sheaves on the nilpotent cone $\mathcal{N}$ of $\mathfrak{g}$. One basis is indexed by Λ^+, the set of dominant weights of G, and the other by Ω, the set of pairs $(\mathcal{O}, \mathcal{E})$ consisting of a nilpotent orbit $\mathcal{O} \subset \mathcal{N}$ and an irreducible G-equivariant vector bundle $\mathcal{E} \to \mathcal{O}$. The existence of the Lusztig–Vogan bijection $\gamma\colon \Omega \to \Lambda^+$ was proven by Bezrukavnikov, and an algorithm computing γ in type A was given by Achar. Herein we present a combinatorial description of γ in type A that subsumes and dramatically simplifies Achar's algorithm.

Screenings, primaries, missing boxes

Alexei Semikhatov, Moscow

The six functors

Wolfgang Soergel, Freiburg

This is some work revisiting the foundations. I learned from Fritz Hrmann what a reasonably concise complete axiomatics for the Grothendieck six functor formalism should be and spent some time to check it in the most elementary context of abelian sheaves on topological spaces.

Defining equations for some nilpotent varieties

Eric Sommers, Amherst

Broer showed that the closure of the subregular nilpotent orbit is a normal variety and found its defining equations in the Lie algebra. We generalize this result to the class of nilpotent orbits that are Richardson orbits for orthogonal short simple roots. The proof involves some cohomological results for line bundles on cotangent bundles of generalized flag varieties to find a sufficient set of equations and then a result using flat bases of invariant polynomials to find a minimal set. This is joint work with Ben Johnson.

Symmetry breaking for representations of orthogonal groups and an introduction to the Gross-Prasad conjectures

Birgit Speh, Cornell University

In 1992 Benedict Gross and Dipendra Prasad published conjectures about the restriction of irreducible tempered representation of special orthogonal groups to a subgroup The interesting feature of them is that they consider packets of irreducible tempered representations defined by Vogan for the larger group G and also for a subgroup G' and conjecture that there exactly on pair of representation Π, π in these packets so that

$$\mathrm{Hom}_G(\Pi; \pi) \neq 0.$$

Indeed there is an algorithm in the paper determining this pair. I will in this talk explain this in detail and show that the symmetry breaking operators for tempered principal series representation of $\mathrm{SO(n+1,1)}$, $\mathrm{SO(n,1)}$ constructed in joint work with T.Kobayashi help to prove this in a special case.

On a generalisation of Capparelli's combinatorial identities for affine symplectic Lie algebras

Tomislav Šikić, Zagreb

At the beginning of this talk I'll give a brief overview of results related to a construction of combinatorial bases of basic and standard modules for affine Lie algebras $C_n^{(1)}$ (arXiv:1603.04399 ; arXiv:1506.05026v2). Based on that construction we formulated the corresponding colored Rogers-Ramanujan type identities which generalize one Capparelli identity. Our interest here is in the conjectured colored Rogers-Ramanujan combinatorial identities for higher levels k and I'll present some numerical evidence in support of the conjecture in the case of $C_2^{(1)}$. This talk is based on a joint work with Mirko Primc.

On certain class of representations for Lie algebras

Boris Širola, Zagreb

Let $\mathfrak{g}$ be a complex semisimple Lie algebra, and $\mathfrak{b}$ its Borel subalgebra containing a Cartan subalgebra $\mathfrak{h}$. We will present a construction of some infinite dimensional (weight) $\mathfrak{g}$-modules $W(\lambda)$, for $\lambda \in \mathfrak{h}^*$, that are determined by the choice of $\mathfrak{b}$. This explicit construction might be considered as a certain algebraic analogue of the standard construction of parabolically induced representations of semisimple Lie groups.

Coincidences among derived functor modules

Peter Trapa, University of Utah

Under a natural positivity hypothesis called the weakly fair range, Vogan proved that the derived functor modules of the form $A_{\mathfrak{q}}(\lambda)$ are unitary. The infinitesimal character of these modules can be singular, and the modules themselves can be zero; when they are nonzero, they can be reducible. Moreover, there can be coincidences among them. In complete generality, it is difficult to determine when this happens. Under further hypotheses related to the construction of Arthur packets for indefinite unitary groups, we prove that no coincidences can occur.

Bases of standard modules for affine Lie algebras of type $C_\ell^{(1)}$

Goran Trupčević, University of Zagreb, Faculty of Teacher Education

Feigin-Stoyanovsky's type subspaces for affine Lie algebras of type $C_\ell^{(1)}$ have monomial bases with a nice combinatorial description. We describe bases of the whole standard modules in terms of semi-infinite monomials obtained as "translations" of monomials for Feigin-Stoyanovsky's type subspace.

Software for unitary representations

David Vogan, MIT

Let G be a linear real reductive Lie group. By the 1980s it was understood that computing the unitary dual of G amounted to answering the question

is π unitary?

for a finite set of irreducible representations π of G. For a fixed π, it was also understood that answering this question amounted to deciding the positivity of a finite collection of symmetric matrices with rational entries; so the answer was in principle computable. But the size of the matrices involved (for $Sp(8, C)$, the largest has size 38,625) made the calculation impractical except for a few very small groups.

Work with Jeffrey Adams, Marc van Leeuwen, and Peter Trapa, and other work with George Lusztig, provided an algorithm based on the Kazhdan-Lusztig algorithm for answering this question. This algorithm has now been implemented in the atlas software: one can enter any G and π, ask whether π is unitary, and receive an answer. I'll demonstrate the software, and talk about the main ideas behind it. I'll discuss some of the details: why five years elapsed between the mathematical formulation of the algorithm and the completion of the software.

You can download the software at
http://atlas.math.umd.edu/software/index.html

The universal Atiyah algebroid

James Waldron, Newcastle

The Atiyah algebroid of a princial G-bundle P is a geometric object which encodes certain features of the geometry of P. Atiyah algebroids are useful in many different settings: in representation theory (twisted differential operators), in complex geometry (the Lie algebra structure on the tangent complex), and in the general theory of Lie algebroids.

I will explain that there is a universal Atiyah algebroid living over the classifying stack of G-bundles. This object can be understood from several different perspectives: via classifying stacks, in terms of Maurer-Cartan elements, or as a certain Harish-Chandra Lie algebroid.

q-Virasoro algebra and affine Lie algebra

Qing Wang, Xiamen University

In this talk, we study a certain deformation of the Virasoro algebra that was introduced and called q-Virasoro algebra by Belov and Chaltikian, in the context of vertex algebra. In the process, the relation between q-Virasoro algebra and affine Kac-Moody algebra of type $B_l^{(1)}$ was obtained. This is a joint work with Hongyan Guo, Haisheng Li and Shaobin Tan.

Affine vertex operator superalgebras at admissible levels

Simon Wood, Cardiff

Affine vertex operator super algebras at non-negative integer levels have enjoyed much attention over the past few decades. They form some of the core examples of rational vertex operator super algebras and hence their module categories are modular tensor categories. Aside from the non-negative integer levels there also exist certain other rational levels called admissible levels where Kac and Wakimoto proved the existence of interesting modular properties. In this talk I will present some of the interesting structure encountered at these levels.

Matsuo algebras and vertex operator algebras

Hiroshi Yamauchi, Tokyo Woman's Christian University

A Matsuo algebra is a commutative non-associative algebras associated to a 3-transposition group. In this talk I will consider vertex operator algebras generated by Griess algebras which are isomorphic to Matsuo algebras.

Gelfand Tsetlin modules over $\mathfrak{gl}(n, \mathbb{C})$ with arbitrary characters

Pablo Zadunaisky, Sao Paolo

Let U be the enveloping algebra of $\mathfrak{gl}(n, \mathbb{C})$. The Gelfand-Tsetlin subalgebra of U, denoted by Γ, is a maximal commutative subalgebra, whose character set is parametrized up to finite multiplicities by points of $\mathbb{C}^{\binom{n}{2}}$. In a series of articles between 88-91, Drozd, Futorny and Ovsienko introduced the notion of a Gelfand-Tsetlin module over U, namely one on which the action of Γ is locally finite, and built a flat family of Gelfand-Tsetlin modules over the space of generic characters of Γ [namely $\mathbb{C}^{\binom{n}{2}}$ minus a denumerable hyperplane arrangement]. Modules in this family have an explicit basis parametrized by tableaux with complex entries, and the action of U is given by rational functions in these entries. In 2016 Futorny, Grantcharov and Ramrez enlarged this flat family to include some points in the exceptional hyperplanes, along with a basis by so-called "derived" tableaux.

In this talk we will review these contructions and show how to extend the family to a flat family of GT-modules over the space of all characters of Γ. Modules in this enlarged family have a basis parametrized by tableaux and further combinatorial invariants, and we give explicit formulas for the action of U in this basis. Joint work with L.E. Ramrez

Discrete component in the branching of vector-valued complementary series of rank one groups

Genkai Zhang, Chalmers University, Göteborg

We study the branching rule of general vector-valued complementary series of rank one groups $U(n,1;K)$ under its symmetric subgroup $U(n-1,1;K)$ for $K=\mathbb{R},\mathbb{C},\mathbb{H}$. We find finitely many discrete components by constructing an integral intertwining operator and estimating its norm in Sobolev spaces. (Joint work with J. Möllers and B. Ørsted).