Saturday, 5/12

Nikolai Reshetikhin, “On Hamiltonian formalism for Batalin–Vilkovisky extensions of gauge theories.”

Perturbative quantization of classical gauge theories may require more complicated setting then the introduction of Faddeev-Popov ghost fields. When the gauge symmetry is given by a distribution which is not necessary comes from a gauge group action one should use Batalin–Vilkovisky extension of the theory. This talk will outline the Hamiltonian framework for such extensions.

Gregg Zuckerman, "An equivalence between two categories of generalized Harish-Chandra modules"

Long ago, in an evil empire, Gelfand and Ponomarev pioneered the study of categories of Harish-Chandra modules. Bernstein, Gelfand and Gelfand pursued the study of categories of highest weight modules. Bernstein and the younger Gelfand discovered equivalences between categories of Harish-Chandra modules--over diagonal pairs--and categories of highest weight modules. In the last dozen years, Penkov, Serganova and Zuckerman have been building a theory of generalized Harish-Chandra modules. We will discuss a conjectural equivalence between a certain category of generalized Harish-Chandra modules and a certain category of generalized highest weight modules. The so-called Zuckerman derived functors will play a central role.

Peter Goddard, “Current Algebra on the Torus”

Anthony Licata, "The basic representation and its categorification"

The basic representation of a simply-laced affine Lie algebra admits several explicit constructions. We'll describe a categorification one of these constructions - the homogeneous realization of Frenkel-Kac-Segal - and describe how various structures like vertex operators and braid groups arise naturally in this categorification. (This is joint work with Sabin Cautis and Josh Sussan.)

~~Seok-Jin Kang, "Categorification of highest weight modules via Khovanov-Lauda-Rouquier algebras"~~

~~Abstract: We prove the "cyclotomic categorification conjecture" proposed by Khovanov and Lauda.~~

Giovanni Felder, "The classical master equation"

We formalize the construction of Batalin and Vilkovisky of a solution of the master equation associated with a polynomial in n variables (or a regular function on a nonsingular affine variety).
We show existence and uniqueness up to "stable equivalence" and discuss the associated BRST cohomology (joint work with David Kazhdan).

Sunday, 5/13

James Lepowsky, "Logarithmic tensor category theory for vertex-algebraic structures"

I'll survey a program developed jointly with Yi-Zhi Huang and Lin Zhang. What we call "logarithmic tensor category theory" develops the general representation theory of vertex (operator) algebras, with a lot of analytic reasoning, to construct natural braided tensor category structure on suitable categories of (generalized) modules. Semisimplicity of the module categories is not assumed; this is naturally related to the logarithms that pervade the theory, starting, at "step zero," with logarithmic intertwining operators. (Intertwining operators had been introduced in the mathematical setting of vertex operator algebra theory in joint work with Igor Frenkel and Huang.) The study of analytic specializations of compositions of logarithmic intertwining operators leads to the general, core theorems constructing "logarithmic operator product expansions," much stronger than braided tensor category data. The notion of vertex operator algebra is a natural "complexification" of the notion of Lie algebra, and the general logarithmic tensor category theory is in fact the corresponding natural (although elaborate) analogue of the following classical triviality in Lie algebra theory: ``Given a Lie algebra (not necessarily semisimple or finite dimensional), consider its symmetric tensor category of modules." While in Lie algebra theory the existence of this symmetric tensor category is just as trivial for a nonsemisimple Lie algebra as it is for an arbitrary one, in vertex algebra theory, logarithmic tensor category theory is considerably more delicate than the theory developed earlier with Huang in the finitely reductive ("rational") case. I'll discuss relations with other work.

Miranda Cheng, "Umbral Moonshine"

In the last century, the monstrous moonshine conjecture initiated the study of the fascinating relation between automorphic objects and sporadic groups. In 2010, Eguchi–Ooguri–Tachikawa observed a surprising connection between the elliptic genus of a K3 surface and the largest Mathieu group. In this talk I report on a conjecture relating a set of special Jacobi forms and the representation theory of a set of finite groups. This set is naturally parametrised by the divisors of 12 and the M24-K3 connection can be identified as one instance of this more general relation. I will also discuss some of the special features of this conjectural relation, including the important role played by mock theta functions and their relation to the imaginary quadratic number field on which certain representations of the finite groups are defined. This talk is based on the pre-print arXiv:1204.2779 in collaboration with John Duncan and Jeff Harvey.

Fedor Malikov, "Localization via vertex algebras"

We shall review the notions of twisted and asymptotic chiral differential operators and show how they can be used to obtain localization (of sorts) of affine and W- algebras at the critical level.

George Lusztig, "A bar operator for involutions in a Coxeter group"

The polynomials P_{y,w} defined in my 1979 paper with Kazhdan for y,w in a Coxeter group W can be refined in the case where y,w are involutions; in that case they are naturally the sum of two other polynomials P^+_{y,w},P^-{y.w}. This talk will give a definition and some properties of these refined polynomials. (The case where W is a Weyl group was done in a joint paper with D.Vogan.)

Monday, 5/14

Catharina Stroppel, "Generalized Khovanov algebras and categorification"

Khovanov's arc algebra plays an important role in categorification and representation theory. It is a combinatorially defined algebra with nice homological and structural properties describing perverse sheaves on Grassmannians as well as categories of finite dimensional super modules and blocks of the walled Brauer algebra.

This talk will give an overview about properties and usefulness of this algebra and also show a few new directions and developments in a quite different direction.

Mikhail Khovanov, "Adventures in categorification"

The concept of categorification was introduced by Louis Crane and Igor Frenkel in 1994 and has since blossomed into a new area of mathematics. We'll review some of the developments in this field and how it was shaped by Igor Frenkel's ideas and vision.

Joel Kamnitzer, "Affine MV polytopes and preprojective algebras"

MV polytopes give a combinatorial model for representation theory of semisimple Lie algebras. They were originally defined in the finite type case using MV cycles in the affine Grassmannian. I will explain how they can be generalized to affine type using generic modules for preprojective algebras. This is joint work with Pierre Baumann and Peter Tingley.

Vera Serganova, "Tensor representations of $gl(\infty)$."

Let g = sl(∞), o(∞) or sp(∞) be a direct limit of classical Lie algebras. We define the category Tg of g-modules in which the tensor algebra of standard and costandard representations is injective. In contrast with finite-dimensional case this category in not semisimple. We show that Tg is Koszul in the sense that it is antiequivalent to the category of (locally unitary) finite-dimensional modules over a certain direct limit of Koszul rings. Then we discuss applications to superalgebras and boson-fermion correspondence.

Hiraku Nakajima, "Coproduct on Yangian"

Consider the Yangian $Y(\mathfrak g)$ associated with an affine Lie algebra $\mathfrak g$, which is not of type $A^{(1)}_1$ nor $A^{(2)}_2$. We define a coproduct Δ, which takes value in a certain completion of $Y(\mathfrak g)\otimes Y(\mathfrak g)$. This is a work in progress, with Nicolas Guay.

Tuesday, 5/15

Dennis Gaitsgory, "Higher conformal blocks for WZW"

Abstract: We will show how the recent result on the contractibility of the space of rational maps from an algebraic curve X to an algebraic group G, implies that space of derived conformal blocks (chiral homology) of the WZW chiral algebra is given by vector space (dual to the space) of cohomology of the corresponding line bundle on the moduli space Bun(G,X).

Edward Frenkel, "The Langlands Program and Geometrization of Trace Formulas"

The Langlands Program relates Galois representations and automorphic representations of reductive algebraic groups defined over number fields and the fields of functions on curves over finite fields. The trace formula is a powerful tool in the study of this connection. After giving a brief introduction to the Langlands Program and its geometric version, which applies to curves over finite fields as well as over the complex field, I will outline a conjectural framework of “geometric trace formulas” in the case that the curve is defined over the complex field. It exploits a categorical formulation of the geometric Langlands correspondence. The talk is based on my joint work with Robert Langlands and Ngo Bao Chau

Toshi Kobayashi, "Geometric Analysis on Minimal Representations"

Minimal representations are the smallest infinite dimensional unitary representations of reductive groups, which may be thought of as a quantization of minimal nilpotent orbits. The Segal-Shale-Weil representation for the metaplectic group, which plays a prominent role inumber theory, is a classic example.

Geometric realizations of minimal representations offer abundant symmetries on function spaces, far more than other (usual) irreducible infinite dimensional representations by the "minimality". Highlighting geometric analysis on minimal representations of indefinite orthogonal groups, I plan to discuss interaction with conformal geometry, conservative quantities of PDEs, an analogue of the Schrodinger model and the Fock model, and a generalized Fourier transform and its deformation theory.

Andrei Okounkov, "Quantum Cohomology of Nakajima varieties"

Based on joint work with Davesh Maulik

Richard Borcherds, "What is a renormalization?"

While every physicist knows what a renormalization is, it is not so easy to find a precise definition anywhere. This talk will give a mathematical definition of renormalizations of a fiber bundle, and show that they have the properties one would expect. In particular renormalizations act simply transitively on a space of Feynman measures.

Wednesday, 5/16

Alexander Braverman, "Affine Tamagawa number formula and Macdonald constant term conjecture"

In the first part of the talk I am going to explain how the so called "Macdonald constant term identity" appears in the theory of Eisenstein series for affine Kac-Moody groups (this is based on joint works with M.Finkelberg, H.Garland, D.Kazhdan and M.Patnaik). In the second half of the talk I will explain how it gives rise to a version of the Tamagawa number formula in the affine case (all the relevant notions will be defined during the talk).

Howard Garland, "Automorphic forms on loop groups"

We will discuss the theory of automorphic forms on affine, Kac-Moody groups. We will construct Eisenstein series, discuss convergence and meromorphic continuation, and as time permits, discuss relations with Y. Zhu's theta functions and with meromorphic continuation of L-functions as proposed by Braverman and Kazhdan.

Yongchang Zhu, "Theta function functional for arithmetic surfaces"

Let Q be a global field, ${\Bbb A}_Q$ be its adele ring. It is known that the Schwartz-Bruhat space ${\cal S }({\Bbb A}_Q) $ has the structure of a representation of a central extension of $Sp_{2n} ({\Bbb A}_Q) $, and the representation is automorphic in the sense that there is a $Sp_{2n} (Q) $-invariant theta functional ${\cal S} ({\Bbb A}_Q) \to {\Bbb C} $.

In this talk we will discuss the generalization of the above results to surfaces X over a finite field and arithmetic surfaces. The adele ring ${\Bbb A}_Q$ is now replaced by the Parshin-Beilinson adeles ${\Bbb A}_X$.

Joseph Bernstein, “Calculus of pseudo-differential operators without Fourier transform”

Usually the definition of pseudo-differential operators is given in terms of Fourier transform. This definition is based on a local approximation of a manifold by a linear space.

In some geometric situations our manifold has additional geometric structures that do not have linear approximation - and then Fourier transform can not be used.

I will describe another definition of pseudo-differential operators that is formulated in more geometric terms and does not use Fourier transform.

I hope that some generalizations of this definition would allow to extend the theory of pseudo-differential operators to more complicated geometric situations. I will describe an important example of such situation that naturally arises in representation theory of reductive groups.

David Kazhdan, "On the second adjointness"

We present a geometric proof of second adjointness for a reductive p-adic group. Our approach is based on geometry of the wonderful compactification and related varieties. Considering asymptotic behavior of a function on the group in a neighborhood of a boundary stratum of the compactification, we get a ”specialization” map between spaces of functions on various varieties with G × G action. These maps can be viewed as maps of bimodules for the Hecke algebra, and the corresponding natural transformations of functors lead to the second adjointness. We also get a formula for the ”specialization” map expressing it as a composition of the orishperic transform and inverse intertwining operator. As a byproduct we obtain a formula for the Plancherel functional restricted to a certain commutative subalgebra in the Hecke algebra, generalizing a result by Opdam.

Thursday, 5/17

Nikita Nekrasov, "The iWeyl groups"

We solve the limit shape equations for the instanton partition functions for the superconformal quiver gauge theories in four dimensions. The moduli space of ADE instantons on R^2 X T^2 is found to be the Seiberg-Witten integrable system for this theory. The relation to the representation theory of Yangians, quantum affine algebras, and elliptic algebras is conjectured. Based on the joint work with Vasily Pestun.

Tetsuji Miwa, “Plane partitions and Representations of Quantum Toroidal Algebra”

The talk is based on a recent preprint “Representations of quantum toroidal gl_n” which is a joint work with B. Feigin, M. Jimbo and E. Mukhin. We construct representations of quantum toroidal algebra with explicit basis parametrized by plane partition. The gl_n case is interesting because we can discuss the restriction of representations to the quantum affine gl_n with generic level.

Pavel Etingof, "Symplectic reflection algebras and affine Lie algebras"

I will present some results and conjectures suggesting that the representation theory of symplectic reflection algebras for wreath products (in particular, cyclotomic rational Cherednik algebras) categorifies certain structures in the representation theory of affine Lie algebras (namely, decompositions of the restriction of the basic representation to finite dimensional and affine subalgebras). These conjectures arose from the insight due to R. Bezrukavnikov and A. Okounkov on the link between quantum connections for Hilbert schemes of resolutions of Kleinian singularities and representations of symplectic reflection algebras. Some of these conjectures were recently proved in the works of Shan-Vasserot and Gordon-Losev.