International Workshop on Algebraic Groups, Quantum Groups and Related topics
Peking University, July 18–22, 2009

Schedule

(All talks are in Rm 1328, Ziyuan Building near the intersection of Zhongguancun Street and 4th Ring Road)

July 18, 2009, Saturday

8:20-8:30	**Jiping Zhang** (Peking Advanced Math Center) Welcome speech
8:30-9:10	**Chongying Dong** (University of California, Santa Cruz) On the uniqueness of the moonshine VOA
9:20-10:00	**Haisheng Li** (Rutgers University, Camden) Quantum vertex algebras and their ϕ-coordinated modules
10:00-10:30	*Tea Break*
10:30-11:10	**Gerard Helminck** (University of Amsterdam) The relative frame bundle of a flag variety and solutions of integrable hierarchies
11:20-12:00	**Chengming Bai** (Chern Institute of Mathematics) The representation theory of Yangians and its application
12:10–	*Lunch in Ziyuan Bldg*
2:30-3:10	**Hanspeter Kraft** (ETH) The Linearization Problem, Old and New
3:20-4:00	**Weiqiang Wang** (University of Virginia) Modular representations for wreath Hecke algebras and affine crystal basis
4:00-4:30	*Tea Break*
4:30-5:10	**Naihong Hu** (East China Normal University) Modular quantization of Cartan type Lie algebras
5:20-6:00	**Ben Cox** (College of Charleston) Realizations of elliptic affine Lie algebras
6:15–	**Banquet** *at Xin Kai Yuan*

July 19, 2009, Sunday

8:20-9:00	**Raphael Rouquier** (Oxford University) 2-Representations of Kac-Moody algebras
9:10-9:50	**Alexander Kleshchev** (University of Oregon) A q-analogue of Ariki's categorification theorem
9:50-10:20	*Tea Break*
10:20-11:00	**Jie Xiao** (Tsinghua University) Tame and Affine
11:10-11:50	**Hebing Rui** (East China Normal University) Blocks of Birman-Murakami-Wenzl algebras
12:00–	*Lunch in Ziyuan Bldg*
2:30-3:10	**Gerald Schwartz** (Brandeis University) Real geometric invariant theory and double coset spaces
3:20-4:00	**Max Horn** (TU-Darmstadt) The geometry of involutions of algebraic groups and of Kac-Moody groups
4:00-4:30	*Tea Break*
4:30-5:10	**Ralph Bremigan** (Ball State University) Moment norm techniques in a hyperkaehler setting
5:20-6:00	**Ralf Gramlich** (TU Darmstadt & Univ. Birmingham) Arithmetic groups over global function fields and lattices of locally compact Kac–Moody groups
6:15–	*Dinner at Shao Yuan*

July 20, 2009, Monday

7:30	Charter Bus for sightseeing Leave from Beijing Friendship Hotel
7:31	Ziyuan Building
5:00	Back to Beijing Friendship Hotel

Charter bus to Badaling Great Wall, the Ming Tomb, etc. Transportation provided free to invited participants.

Estimated admission fees: Great Wall, Y80; Ming Tomb, Y70.

July 21, 2009, Tuesday

8:20-9:00	**Jiping Zhang** (Peking University) Block coverings in finite groups
9:10-9:50	**Jianshu Li** (The Hong Kong University of Science and Technology) Non-negativity of central values of L-functions
9:50-10:20	*Tea Break*
10:20-11:00	**Alistair Savage** (University of Ottawa) Finite-dimensional representations of equivariant map algebras
11:10-11:50	**Liangang Peng** (Sichuan University) Symmetrizable intersection matrices and their root systems
12:00–	*Lunch in Ziyuan Bldg*
2:30-3:10	**Feng Xu** (University of California, Riverside) Mirror extensions and applications
3:20-4:00	**Changchang Xi** (Beijing Normal University) Homological dimension of affine Hecke algebras
4:00-4:30	*Tea Break*
4:30-5:10	**Milen Yakimov** (Lousiana State University) Spectra of quantum Schubert cells and quantum flag varieties
5:20-6:00	**Jacob Greenstein** (University of California, Riverside) TBA
6:15–	*Dinner at Shao Yuan*

July 22, 2009, Wednesday

8:20-9:00	**Marc Rosso** (Université Paris 7)) TBA
9:10-9:50	**Ruth Haas** (Smith College) Involutions and Twisted Involutions of Coxeter Groups
9:50-10:20	*Tea Break*
10:20-11:00	**Dan Nakano** (University of Georgia) Atypicality, complexity and module varieties for classical Lie superalgebras
11:30	*Lunch in Ziyuan Bldg*

Abstracts

Chongying Dong
University of California, Santa Cruz

On the uniqueness of the moonshine VOA

We will review recent progress on proving Frenkel-Lepowsky-Meurman's conjecture on the uniqueness of the moonshine VOA.

Haisheng Li
Rutgers University, Camden

Quantum vertex algebras and their ϕ-coordinated modules

We introduce a notion of ϕ-coordinated (quasi) module for a nonlocal vertex algebra and we establish a conceptual construction of nonlocal vertex algebras and their ϕ-coordinated (quasi) modules. As an application, we associate quantum affine algebras with what we called weak quantum vertex algebras in a previous paper, and we also associate a certain quantum $\beta\gamma$-system with quantum vertex algebras and ϕ-coordinated modules.

Gerard Helminck
University of Amsterdam

The relative frame bundle of a flag variety and solutions of integrable hierarchies

In this talk it will be explained how the relative frame bundle of an infinite dimensional flag variety can be used to construct solutions of integrable hierarchies in the upper triangular $\mathbb{Z} \times \mathbb{Z}$-matrices.

Chengming Bai
Chern Institute of Mathematics

The representation theory of Yangians and its application

I will give a brief introduction to Yangians and their application. In particular, I will pay main attention to the representation theory of Yangians $Y(sl(2))$ and $Y(sl(3))$ and its application in some physical models.

Hanspeter Kraft
University of Basel

The Linearization Problem, Old and New

The linearization problem asks if an action of a reductive algebraic group on complex affine n-space is equivalent to a linear representation. The first counterexamples were given by G. W. Schwarz in 1989; they initiated an interesting development. We will describe some highlights, some open problems and some recent developments.

Weiqiang Wang
University of Virginia

Modular representations for wreath Hecke algebras and affine crystal basis

I will explain part of the dissertation of Jinkui WAN at Virginia. A generalization of the degenerate affine Hecke algebra, called wreath Hecke algebra, associated to an arbitrary finite group is introduced. The simple modules of the wreath Hecke algebra are classified over any characteristic. The modular branchings for these algebras and their cyclotomic quotients (which include the wreath products as a special case) are obtained, and they are further identified with crystal graphs for quantum affine algebras.

Naihong Hu
East China Normal University

Modular quantization of Cartan type Lie algebras This is a joint work with

Wang Xiuling. In this talk, we will recall the quantization in the sense of Drinfeld, and then to talk about how to derive the modular quantization for the Cartan type Lie algebras, for instance, types W and S. Our modular reduction procedures including modulo p reduction and modulo restrictedness reduction, as well as base changes, are proved to be reserved by the Hopf algebras axioms.

Ben Cox
College of Charleston

Realizations of elliptic affine Lie algebras

In this talk we will show how one can construct free field type realizations of the elliptic affine Lie algebra $\mathfrak{sl}(2,R) \oplus \Omega_R/dR$ where $R = \mathbb{C}[t, t^{-1}, u \,|\, u^2 = t^3 - 2bt^2 + t]$. This is joint work with A. Bueno, and V. Futorny.

Raphael Rouquier
Oxford University

2-Representations of Kac-Moody algebras

I will explain how to develop a categorical version of integrable representation theory. This can be done algebraically or geometrically.

Alexander Kleshchev
University of Oregon

A q-analogue of Ariki's categorification theorem

We present our joint results with Brundan which give an algorithm for computing q-decomposition numbers for complex Hecke algebras of symmetric groups at roots of unity. At q=1, this is a theorem of Ariki.

Jie Xiao
Tsinghua University

Tame and Affine

We will explain how to the relationship between canonical bases of quantum affine algebras and tame quivers.

Hebing Rui
East China Normal University

Blocks of Birman-Murakami-Wenzl algebras

We classify the block of Birman-Murakami-Wenzl algebras $B_n(r,q)$ under the assumption $o(q^2) > n$. As a byproduct, we will give a criterion for each cell module of $B_n(r,q)$ being equal to its simple head over an arbitrary field.

This is a joint work with M. Si.

Gerald Schwartz
Brandeis University

Real geometric invariant theory and double coset spaces

Let G be the real form of a complex reductive group. Suppose that we are given involutions σ and θ of G. Let $H = G^\sigma$ denote the fixed group of σ and let $K = G^\theta$ denote the fixed group of θ. We are interested in calculating the double coset space $H\backslash G/H$. We use techniques of real invariant theory to calculate double cosets, especially the ones that are closed. We give a brief review of the necessary results from geometric real invariant theory.

Max Horn
Technische-Universität Darmstadt

The geometry of involutions of algebraic groups and of Kac-Moody groups

Untwisted finite groups of Lie type, reductive algebraic groups and Kac-Moody groups share a unifying feature: They all admit so-called (twin) BN-pairs, which in turn induce a simplicial complex with a natural action by the group, a so-called *(twin) building*. Many important features of groups with BN-pair are reflected in their associated buildings, allowing the application of geometric methods for studying the groups. Indeed buildings have become an important tool in the theory of these classes of groups.

For this talk, let G be a group as listed above with building Δ, and let *theta* be an involutory automorphism of G, and let $K := \mathrm{Fix}_G(\theta)$. Possibilities for K include twisted groups and unitary forms of algebraic and Kac-Moody groups. In this talk we introduce a geometry Δ^θ (a subcomplex of Δ), the *Phan geometry* with respect to θ. Like buildings, these geometries have many fruitful applications when studying K. Here, we show that this geometry is residually connected under some mild assumptions on G. From this we conclude that K is finitely generated.

Ralph Bremigan
Ball State University

Moment norm techniques in a hyperkaehler setting

F. Kirwan and others developed a theory for stratifying Kaehler manifolds which admit an action of a complex reductive group G. Many questions are reduced to the study of orbits of a maximal compact subgroup of G on a subset of the manifold. Recently, Heinzner, Schwarz, and Stoetzel extended the theory to actions of real reductive groups. In certain hyperkaehler settings, one can study a 2-sphere of related group actions. I will discuss the example of $SL(2,\mathbb{C})/SO(2,\mathbb{C})$ and the cotangent bundle of the flag variety of $SL(2,\mathbb{C})$, whose $SL(2,\mathbb{C})$ actions are related in this hyperkaehler sense.

Ralf Gramlich
TU Darmstadt / University of Birmingham

Arithmetic groups over global function fields and lattices of locally compact Kac–Moody groups

Affine split Kac–Moody groups over finite fields and semisimple split algebraic groups over global function fields are closely related; both act on affine twin buildings as their natural geometries. In my talk I will report on the recent progress in the theory of arithmetic groups over local function fields and of lattices in locally compact Kac–Moody groups. The main focus will be on 1) topological finiteness properties of certain arithmetic groups, 2) the known examples of lattices of non-spherical non-affine locally compact Kac–Moody groups, 3) Mostow rigidity of one such class of lattices, 4) open questions. The geometric foundations required for this talk will be laid in Dr. Max Horn's presentation.

Jiping Zhang
Peking University

Block coverings in finite groups

We say that a finite group G is principally covered if any irreducible complex character of G lies in the principal p-block of G for some prime p. It has been conjectured that if G is principally covered then either G has only one p-block for some prime p or the Fitting subgroup of G is trivial. In this talk we confirm the conjecture, we also almost determine the generalized Fitting subgroup of G. This is a joint work with C. Bessenrodt.

Jianshu Li
The Hong Kong University of Science and Technology

Non-negativity of central values of L-functions

Let $L(s,\pi)$ be the "standard" L-function of an automorphic cuspidal representation of the general linear group. Then, as predicted by the generalized Riemann hypothesis, the central value $L(\frac{1}{2},\pi)$ should be non-negative. In this talk we shall outline a proof of this fact in the case when π arises from a cohomological cuspidal automorphic form of a suitable unitary group. This is a recent joint work with Michael Harris.

Alistair Savage
Université d'Ottawa

Finite-dimensional representations of equivariant map algebras

Suppose a finite group acts on an algebraic variety X and a simple Lie algebra g. Then the space of equivariant algebraic maps from X to g is a Lie algebra under pointwise multiplication. Examples of such equivariant map algebras include (multi)current algebras, (multi)loop algebras, three point Lie algebras, and the Onsager algebra. In this talk we will present a classification of the finite-dimensional representations of an arbitrary equivariant map algebra. It turns out that (almost) all finite-dimensional representations are evaluation representations. As a corollary, we recover known results on the representation theory of particular equivariant map algebras (for instance, the loop algebras and the Onsager algebra) as well as previously unknown classifications of other equivariant map algebras (for example, the generalized Onsager algebra). All such classifications are specializations of the general theorem. This is joint work with Erhard Neher and Prasad Senesi.

Liangang Peng
Sichuan University

Symmetrizable intersection matrices and their root systems

This is a joint work with Mang XU.

Motivated by the theory of isolated singularities, P. Slodowy introduced generalized intersection matrices. In this talk we consider symmetrizable generalized intersection matrices, which we call symmetrizable intersection matrices. Every such matrix can be associated naturally to a root basis and a Weyl root system. Our main results are as follows:

We prove that any symmetrizable intersection matrix A which is positive semi-definite with corank$A \leq 1$ is braid equivalent to a Cartan matrix or an affine generalized Cartan matrix. In this case, as a consequence we obtain that the intersection matrix Lie algebra of A in sense of Slodowy is isomorphic to a semi-simple or affine Kac-Moody Lie algebra.

From an arbitrary Cartan Matrix, we define its (standard) d-fold affinization matrix by adding some single roots or diploid roots of the Cartan matrix. This generalizes the corresponding notion of S. Berman and R. V. Moody and of G. Benkart and E. Zelmanov, where they only consider to add some single roots. We furthermore prove that any symmetrizable intersection matrix which is positive semi-definite is braid equivalent to a d-fold affinization matrix. And under braid equivalence, by introducing the type of a d-fold affinization matrix and using standard d-fold affinization matrices we give a classification of all symmetrizable intersection matrices which are positive semi-definite.

Finally, we give an explicit structure of the Weyl root system for each d-fold affinization matrices by using the root system of the Cartan matrix and some special imaginary roots.

Feng Xu

University of California, Riverside
Mirror extensions and applications
TBA

Changchang Xi
Beijing Normal University
Homological dimension of affine Hecke algebras

Abstract: As is well-known, global dimension of an algebra is of particular interest in many mathematical branches, for example, the finiteness of the global dimension of the coordinate ring of an algebraic variety reflects the geometric smoothness of the variety. In this talk, we shall consider the global dimension of the affine Hecke algebras H(R,n,q) of type A over a field R, and show that if the characteristic of R is zero and the Poincare polynomial does not vanish at the quantum parameter q, then H(R,n,q) has finite global dimension. The proof of this result is based on developments of homological properties of affine cellular algebras introduced recently.

This talk reports a part of a joint work with Steffen Koenig.

Milen Yakimov
Lousiana State University
Spectra of quantum Schubert cells and quantum flag varieties

De Concini, Kac, and Procesi defined a family of subalgebras U_q^w of a quantized universal enveloping algebra $U_q(g)$, associated to the elements of the corresponding Weyl group W. They are deformations of universal enveloping algebras of nilpotent Lie algebras and can be considered as quantized algebras of functions on Schubert cells.

We will describe explicitly all torus invariant prime ideals of the algebras U_q^w, construct efficient generating sets, and describe the poset of those ideals. We will then apply these results to classify the torus invariant prime ideals of quantum partial flag varieties.

Jacob Greenstein
University of California, Riverside
TBA

TBA

Marc Rosso
Université Paris 7
Title

TBA

Dan Nakano
University of Georgia
Atypicality, complexity and module varieties for classical Lie superalgebras

Let $\mathfrak{g} = \mathfrak{g}_0 \oplus \mathfrak{g}_1$ be a classical Lie superalgebra and $\mathcal{F}$ be the category of finite dimensional $\mathfrak{g}$-supermodules which are semisimple over $\mathfrak{g}_0$. In this talk we investigate the homological properties of the category $\mathcal{F}$. In particular we prove that $\mathcal{F}$ is self-injective in the sense that all projective supermodules are injective. We also show that all supermodules in $\mathcal{F}$ admit a projective resolution with polynomial rate of growth and, hence, one can study complexity in $mathcalF$. If $\mathfrak{g}$ is a Type I Lie superalgebra we introduce support varieties which detect projectivity and are related to the associated varieties of Duflo and Serganova. If in addition fg has a (strong) duality then we prove that the conditions of being tilting or projective are equivalent.