

21COE
RIMS Research Project 2004
**Quantum Integrable Systems and Infinite
Dimensional Algebras**

February 4 (Wed)–10(Tue), 2004

by Research Institute for Mathematical Sciences & Department of
Mathematics, Kyoto University

SCHEDULE

4 (wed)	9:30 - 10:20	10:30 - 11:20	11:40 - 12:30		15:00 - 15:50	16:00 - 16:50
	B. Feigin	D. Lebedev	S. Loktev		B. Ponsot	E. Feigin
5 (thur)	9:30 - 10:20	10:30 - 11:20	11:40 - 12:30		15:00 - 15:50	16:00 - 16:50
	F. Smirnov	Y. Pugai	A. Semikhatov		A. Nakayashiki	J. Shiraishi
6 (fri)	9:30 - 10:20	10:30 - 11:20	11:40 - 12:10	12:20 - 12:50	15:00 - 15:50	16:00 - 16:50
	B. Feigin	I. Tipunin	Y. Takeyama	M. Kasatani	H. Boos*	M. Takahashi*
7 (sat)	9:30 - 10:20	10:30 - 11:20	11:40 - 12:10	12:20 - 12:50		
	S. Lukyanov*	J. Suzuki*	T. Arakawa*	T. Kuwabara*		
9 (mon)	9:30 - 10:20	10:30 - 11:20	11:40 - 12:30			
	I. Cherednik	M-K-T#	E. Sklyanin			
10 (tue)	9:30 - 10:20	10:30 - 11:20	11:40 - 12:30			
	M. Wakimoto	V. Bazhanov	K. Nagatomo			

Place: All the lectures except * will be held at the Faculty of Engineering 4-go-kan (No. 4 building) 1st Floor. The lectures with * will be held at Dai kaigishitsu (Big Conference Room) of the Dept. of Mathematics.

#: J.-M. Maillet, N. Kitanine and V. Terras

TITLE AND ABSTRACT (alphabetical order)

- T. ARAKAWA (Nagoya Univ.)

Representations of W-algebras and Frenkel-Kac-Wakimoto conjecture

abstract. We study the representations of W-algebras via the quantized reduction introduced by Feigin-Frenkel. The conjecture of Frenkel-Kac-Wakimoto is (partially) proved as a consequence.

- V. BAZHANOV (Australian National Univ.)

TBA

- A. BELAVIN (Landau Institute)

TBA

- H. BOOS (Univ. of Tokyo)

qKZ and correlation functions: Algebraic way

- I. CHEREDNIK (Univ. of North Carolina)

Double Affine Hecke Algebras and Verlinde Algebras

abstract. Introduced 13 years ago, DAHA play now a solid role in modern representation theory with wide spectrum of applications. I will begin with general motivation and the definition in the rank one case. The connections to Verlinde algebras will be discussed, as well as recent results on the diagonal coinvariants (the combinatorics of two sets of variables).

- B. FEIGIN (Landau Institute)

Shubert varieties and the fusion products

abstract. We study the fusion product (the deformation of the tensor product) of \mathfrak{sl}_2 modules. Shubert variety is the closure of the $SL_2(\mathbb{C}[t])$ -orbit of the lowest weight vector in the projectivization of the fusion product. We study algebro-geometric properties of the Shubert varieties. For example, we prove that the fusion product can be reconstructed as a dual space of the sections of some line bundle on the Shubert variety.

- E. FEIGIN (Moscow State Univ.)

TBA

- M. KASATANI (Kyoto Univ.)

Zeros of Symmetric Laurent Polynomials of Type $(BC)_n$ and Self-dual Koornwinder-Macdonald Polynomials Specialized at $t^{k+1}q^{r-1} = 1$

abstract. A characterization of the space of symmetric Laurent polynomials of type $(BC)_n$ which vanish on a certain set of submanifolds is given by using the self-dual Koornwinder-Macdonald polynomials. A similar characterization was given previously for symmetric polynomials of type A_n by using the Macdonald polynomials.

We use a new method which exploits the duality relation. The method simplifies a part of the proof in the A_n case.

- T. KUWABARA (Kyoto Univ.)

Symmetric coinvariant algebra and local Weyl module at a double point

abstract. The symmetric coinvariant algebra $\mathbb{C}[x_1, \dots, x_n]_{S_n}$ is the quotient algebra of the polynomial ring by the ideal generated by symmetric polynomials vanishing at the origin. Classically, it is known that the algebra is isomorphic to the regular representation of S_n .

Replacing $\mathbb{C}[x]$ with $A = \mathbb{C}[x, y]/(xy)$, we introduce another symmetric coinvariant algebra $A_{S_n}^{\otimes n}$ and determine its S_n -module structure. As a corollary, we calculate the dimension of the local Weyl module at a double point for $\mathfrak{sl}_2 \otimes A$.

- D. LEBEDEV (ITEP)

Representation theory and quantum integrability

- S. LOKTEV (Kyoto Univ.)

Weyl modules over two-dimensional currents

abstract. Talk is based on joint papers of Boris Feigin and the speaker. We discuss Weyl modules in the sense of V.Chari and A.Pressley over the Lie algebra of currents in two variables with values in gl_n . The goal of the talk is to describe how these modules are related to space of diagonal coinvariants (in the sense of M.Haiman) and parking functions.

- S. LUKYANOV (State Univ. of New Jersey)

Integrable boundary flows: New face of Baxter's ideas

abstract. In this talk the following two issues will be discussed:

-Boundary RG flows as a dynamic framework in the problems of Dissipative Quantum Mechanics and open String Theory;

-A relation between the integrable boundary states and Baxter's families of commuting transfer matrixes.

- J.-M. MAILLET (ENS, Lyon),
N. KITANINE (Univ. of Cergy-Pontoise) and
V. TERRAS (Univ. Montpellier II)

Correlation functions of the XXZ Heisenberg chain : recent advances

abstract. We review recent progress in the computation of correlation functions of the XXZ spin-1/2 chain and their long distance asymptotic behavior. Our method is based on the resolution of the quantum inverse scattering problem in the framework of the algebraic Bethe ansatz. It leads to multiple integrals representations of the correlation functions in the context of which we discuss their long distance asymptotic behavior.

- K. NAGATOMO (Osaka Univ.)
Conformal field theories associated to vertex operator operator algebras (JOINT WORK WITH A.TSUCHIYA AND A.MATSUO)

- A. NAKAYASHIKI (Kyushu Univ.)
The space of local fields as a module over the ring of local integrals of motion

abstract. The space of local fields of the SU(2)-invariant Thirring model as a module over the ring of local integrals of motion is studied. We construct a free resolution of it in terms of the Fock space of free fermions.

- B. PONSOT (CEN Saclay)
Boundary Liouville field theory and 2D quantum gravity

abstract. Liouville field theory on the disc with Neumann conditions on the Liouville field is considered. We show that the functional equations satisfied by the diverse structure constants (boundary two point function, bulk-boundary function, boundary three point function) have identical structure.

Then we show that the microscopic realization of 2D Quantum Gravity as a height model on a random surface leads to similar equations. We conclude that the discrete approach is able to reproduce the dependence on the boundary parameters of the correlation functions of Liouville theory.

JOINT WORK WITH KOSTOV AND SERBAN.

- Y. PUGAI (Landau Inst.)
On local operators in perturbed CFT

abstract. We discuss some new results on local operators in the integrable perturbations of the minimal CFT in the form factor and conformal perturbation theory approaches. We argue that Zamolodchikov-Zamolodchikov reflection relations may bring useful information on the structure of space of local operators in the form-factor description.

- A. SEMIKHATOV (Lebedev Physics Inst.)
 $W_n^{(2)}$ Algebras

abstract. We construct W-algebra generalizations of the $\widehat{sl}(2)$ algebra — W algebras $W_n^{(2)}$ generated by two currents E and F with the highest pole of order n in their OPE. The $n=3$ term in this series is the Bershadsky–Polyakov $W_3^{(2)}$ algebra. We define these algebras as a centralizer (commutant) of the $U_qsl(n|1)$ super quantum group and explicitly construct the generators via a “Miura-like” construction. Another construction of the WWn algebras is in terms of the coset $\widehat{sl}(n|1)/\widehat{sl}(n)$. The relation between the two constructions involves the “duality” $(k+n-1)(k'+n-1)=1$ between levels k and k' of two $\widehat{sl}(n)$ algebras.

JOINT WORK WITH B. FEIGIN.

- J. SHIRAISHI (Univ. Tokyo.)
TBA

- E. SKLYANIN (Univ. of York) *Q-operator and Separation of Variables*

abstract. Q-operator is a one- or multiparametric family of operators sharing the eigenfunctions with commuting Hamiltonians of a given quantum integrable system. The eigenvalues of Q-operator satisfy a differential or difference equation which allows to determine its spectrum. We give a review of applications of Q-operators. In particular, we show that knowing a Q-operator allows to construct a generic separation of variables for the integrable system in question. Our main illustrative example is the Calogero-Sutherland model.

- F. SMIRNOV (LPTHE)
Connecting lattice and relativistic models via conformal field theory

abstract. We consider the quantum group invariant XXZ-model. In infrared limit it describes Conformal Field Theory (CFT) with modified energy-momentum tensor. The correlation functions are related to solutions of level -4 of qKZ equations. We describe these solutions relating them to level 0 solutions. We further consider general matrix elements (form factors) containing local operators and asymptotic states. We explain that the formulae for solutions of qKZ equations suggest a decomposition of these matrix elements with respect to states of corresponding CFT.

- J. SUZUKI (Shizuoka Univ.)
TBA

- M. TAKAHASHI (Univ. Tokyo)
Correlation function of spin 1/2 XXZ chain

- Y. TAKEYAMA (Kyoto Univ.)
A monomial basis for the Virasoro minimal series $M(p, p')$: the case $1 < p/p' < 2$

abstract. We present a basis of the Virasoro minimal series $M(p, p')$ in the case of $1 < p/p' < 2$. It is given by a certain set of monomials of Fourier components of the $(2, 1)$ -primary field. Our basis has good correspondence to a combinatorial formula of the character of $M(p, p')$. This is a joint work with B. Feigin, M. Jimbo, T. Miwa and E. Mukhin.

- I. TIPUNIN (Tamm Theory Division)
Nonsemisimple Fusion Algebras and the Verlinde Formula

abstract. A nonsemisimple fusion algebra $falgebra_p$ associated with each $(1, p)$ Virasoro model is found. A nonsemisimple generalization of the Verlinde formula which allows us to derive $falgebra_p$ from modular transformations of characters is presented.

- M. WAKIMOTO(Kyushu Univ.)
TBA