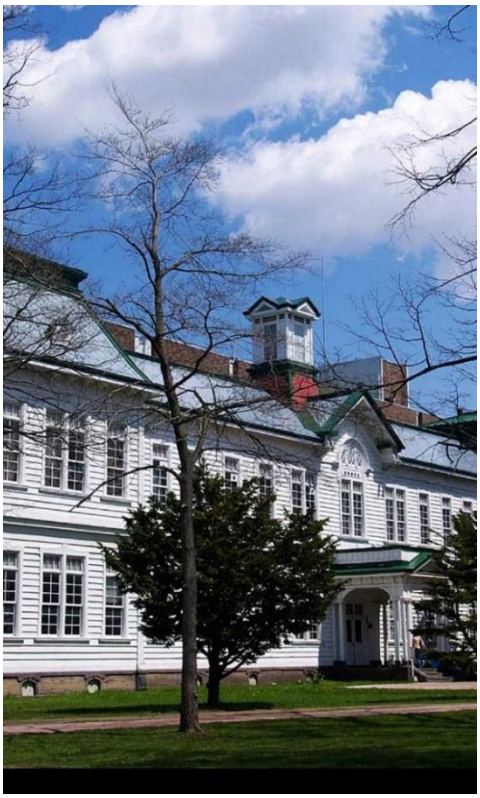
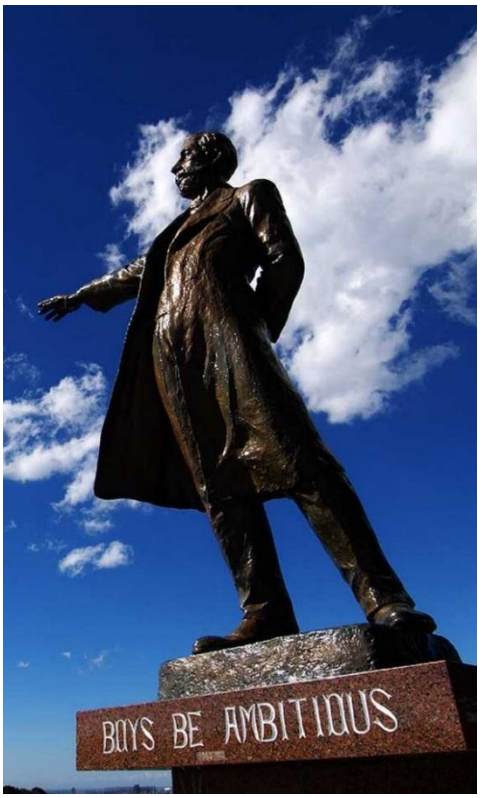
International Workshop on
Noncommutative Analysis and its Future Prospects





Sapporo, August 5-7, 2013

Program

August 5 (Mon)

10:00-10:50 Marek Bożejko (University of Wrocław, Poland)
Generalized Gaussian processes and positive definite functions on permutations groups

11:00-11:50 Zied Ammari (Université de Rennes I, France)
De Finetti theorems and their applications to the mean field problem

LUNCH

13:30-14:15 Izumi Ojima (Kyoto University, Japan)
Geometry of symmetry breaking

14:20-15:10 Luis Velazquez (Universidad de Zaragoza, Spain)
Quantum recurrence and Schur functions

15:20-15:50 Takao Namiki (Hokkaido University, Japan)
The Baker's transformation and quantum walk

15:50-16:20 Etsuo Segawa (Tohoku University, Japan)
Limit behavior of quantum walks on half line related to orthogonal polynomials

August 6 (Tue)

10:00-10:50 Christian Gérard (Université Paris-Sud, France)
Construction of Hadamard states by pseudo differential calculus

11:00-11:50 Un Cig Ji (Chungbuk National University, Korea)
Differential equations in quantum white noise theory

LUNCH

13:45-14:30 Asao Arai (Hokkaido University, Japan)
Asymptotic expansions in the coupling constant for the ground state energy of the generalized spin-boson model

14:35-15:20 Itaru Sasaki (Shinshu University, Japan)
Multiplicity of eigenvalues of the non-commutative harmonic oscillator

15:30-16:15 Hiroaki Yoshida (Ochanomizu University, Japan)
Applications of dissipation formulas of the relative free entropy

16:20-17:05 Kenichiro Tanabe (Hokkaido University, Japan)
A generalization of twisted modules over vertex algebras

DINNER

August 7 (Wed)

10:00-10:50 Demosthenes Ellinas (Technical University of Crete, Greece)
Phase plane operator valued probability measures: Constructions and random evolution

11:00-11:50 Tullio Ceccherini-Silberstein (Università degli Studi del Sannio di Benevento, Italy)
Advanced Mackey theory for finite groups

LUNCH

13:30-14:15 Hiroshi Mizukawa (National Defense Academy of Japan)
Interactions between Ehrenfest's urns arising from group actions

14:20-15:05 Tatsuya Tate (Tohoku University, Japan)
The Hamiltonians generating one-dimensional discrete-time quantum walks

15:10-15:55 Tatsuro Ito (Kanazawa University, Japan)
TD-algebras at q=1

Abstracts

Zied Ammari (Université de Rennes I, France) zied.ammari@univ-rennes1.fr

De Finetti theorems and their applications to the mean field problem

De Fintti's theorem is an elegant result illustrating the importance of symmetry both in classical and non-commutative frameworks. I will review some old and recent applications of the (Quantum) De Finetti theorem for the mean field problem of symmetric multi-particle systems.

Asao Arai (Department of Mathematics, Hokkaido University, Japan)
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Asymptotic expansions in the coupling constant for the ground state energy of the generalized spin-boson model

A new asymptotic perturbation theory is presented. As an application of it, asymptotic expansions in the coupling constant for the ground state energy of the generalized spin-boson model are derived up to any finite order of the coupling constant.

References:
A. Arai, A new asymptotic perturbation theory with applications to models of massless quantum fields, Hokkaido University Preprint Series #1023
http://eprints3.math.sci.hokudai.ac.jp/2239/ ; mp_arc 12-50
http://www.ma.utexas.edu/mp_arc/ To be published in Annales Henri Poincare.

Marek Bożejko (Institute of Mathematics, University of Wrocław, Poland)
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Generalized Gaussian processes and positive definite functions on permutations groups

We will present many examples of generalized Gaussian processes connected with positive definite functions o permutations groups. Connections with free probability and free convolutions on real line will be also done. We will construct explicitly the generalized Gaussian process related to the function on pair-partition defied by Bryc, Dembo and Jiang: $h(V)$ is the number of singletons in a pair partition V. This is connected with new norms on the permutations groups.

Tullio Ceccherini-Silberstein (Dipartimento di Ingegneria, Università degli Studi del Sannio di Benevento, Italy) tceccher@mat.uniroma3.it

Advanced Mackey theory for finite groups

We expose two contributions of Mackey (a criterion for symmetric Gelfand pairs and a characterization of simply reducible groups) togethr with some more recent results of Kawanaka-Matsuyama and Bump-Ginzburg (a twisted version of the Frobenius-Schur theorem) in the setting of the representation theory of a finite group equipped with an involutory antiautomorphism (generalizing the antiautomorphism $g \mapsto g^{-1}$).

Demosthenes Ellinas (Department of Sciences, Technical University of Crete, Greece)
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Phase plane operator valued probability measures: Constructions and random evolution

Operator valued measures (OVM) are introduced on symplectic phase plane (PP), by means of quasi-probability Wigner function. Employing the metaplectic group MSp(2), constructions of such OVM for various PP regions (a.k.a region operators), are carried out. Stochastic increments, operating at the level of Wigner function/region operator, are then introduced algebraically via a commutative/co-commutative Hopf algebra of PP functions, together with a shift invariant functional. Dually we use completely positive trace preserving maps, operating at the level of PP state-density operator. In this way an algebraic random walk and its associated classical random walk is derived. Its asymptotic limit is shown to lead to a quantum master equation for the density operator or dually to a generalized diffusion equation for Wigner function. Analogous constructions with OVMs endowed with positivity (POVM), are worked out based on the representation theory of group ISO(2), which offers common ground for comparing the ensuing classical, algebraic and quantum random walks.

Christian Gérard (Département de Mathématiques, Université Paris-Sud, France)
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Construction of Hadamard states by pseudo differential calculus

We give a new construction based on pseudo differential calculus of quasi-free Hadamard states for Klein-Gordon fields on space-times whose metric is well behaved at space like infinity. In particular we construct all pure Hadamard states with pro covariances and describe their changes under symplectic transformations. We also give a new construction of Hadamard states on general space-times. (Joint work with Michal Wrochna.)

Tatsuro Ito (Institute of Science and Engineering, Kanazawa University, Japan)
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TD-algebras at q=1

TD-algebras at q=1 arise as limits of the q-Onsager algebra. They belong to a wider class than we naively guess, where the Onsager algebra is regarded as certain degenerate case. I will discuss finite-dimensional irreducible representations of TD-algebras at q=1.

Un Cig Ji (Department of Mathematics, Chungbuk National University, Korea)
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Differential Equations in Quantum White Noise Theory

Under the framework of quantum white noise theory, we study a general form of differential equation of white noise operators. In particular, we consider differential equations associated with quantum white noise derivatives. As applications, we study implementation problems of CCR relations and norm ordered forms of composition of certain white noise operators.

Hiroshi Mizukawa (National Defense Academy of Japan) mzh@nda.ac.jp

Interactions between Ehrenfest's urns arising from group actions

In this talk, we consider stochastic models of r urns and n balls under interactions between urns. Let (K, L) be a Gelfand pair of finite groups with $[K:L] = r$. By identifying the set of urns with the right coset K/L, the action of K can describe an interaction between urns. In this situation, we can see that the Gelfand pair $(K \wr S_n, L \wr S_n)$ works well to analyze the model.

Takao Namiki (Department of Mathematics, Hokkaido University, Japan)
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The Baker's transformation and quantum walk

The Baker's transformation is a typical example of uniformly hyperbolic dynamical system. We can define a quantum walk driven by the Baker's transformation and show that the quantum walk has the same statistical property as the classical random walk has. Recently quantum Baker's transformation also has been studied. In the presentation properties of quantum walk driven by quantum Baker's transformation are described.

Izumi Ojima (RIMS, Kyoto University, Japan) ojima@kurims.kyoto-u.ac.jp

Geometry of symmetry breaking

In this talk, we clarify the geometrical structure and the roles of a classifying space of sectors consisting of order parameters emerging from a symmetry breaking of a physical system.

Itaru Sasaki (Shinshu University, Japan) isasaki@shinshu-u.ac.jp

Multiplicity of eigenvalues of the non-commutative harmonic oscillator

We consider the multiplicity of eigenvalues of non-commutative harmonic oscillator (NCHO) $Q(\alpha, \beta)$. We show that the multiplicity of the lowest eigenvalue is one for all values of α and β. We will also discuss the relationship between the NCHO and the Jacobi matrices.

Etsuo Segawa (Graduate School of Information Sciences, Tohoku University, Japan)
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Limit behavior of quantum walks on half line related to orthogonal polynomials

We treat some quantum walks on the positive integer lattice which are related to orthogonal polynomials on the line and also unit circle. We find a new stochastic behavior of quantum walks from these models called strongly ballistic scattering in my talk.

Kenichiro Tanabe (Department of Mathematics, Hokkaido University, Japan)
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A generalization of twisted modules over vertex algebras

For an arbitrary positive integer T I will introduce a notion of a (V, T)-module over a vertex algebra V, which is a generalization of a twisted V-module. I construct an associative algebra $A^T(V)$ and establish a one-to-one correspondence between the set of isomorphism classes of the simple left $A^T(V)$-modules and that of the simple (V, T)-modules.

Tatsuya Tate (Mathematical Institute, Tohoku University, Japan) tate@math.tohoku.ac.jp

The Hamiltonians generating one-dimensional discrete-time quantum walks

In the talk, a concrete formula for the Hamiltonians generating one-dimensional discrete-time quantum walks will be given. The way to deduce the formula will be explained. It turns out that the Hamiltonian for discrete-time quantum walk defines naturally operators acting on scalar functions. Relations between these operators and the transition operator for classical random walk will be discussed.

Luis Velazquez (Departamento de Matematica Aplicada, Universidad de Zaragoza, Spain)
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Quantum recurrence and Schur functions

A relation between the theory of Schur functions and a notion for recurrence in discrete-time quantum systems has been recently discovered. This is the origin of a rich interplay between spectral theory, complex analysis, orthogonal polynomials theory and the issue of quantum recurrence. The above connection not only provides new analytical techniques for quantum mechanical problems, but also reveals an unexpected geometrical and a topological meaning of some recurrence properties of quantum systems. We will review some of these results and their surprising physical consequences. The results that will be reviewed are the fruit of joint works with Albert Werner and Reinhard Werner (Leibniz Universität Hannover), Jean Bourgain (IAS Princeton), Alberto Grünbaum and Jon Wilkening (UC Berkeley).

References:

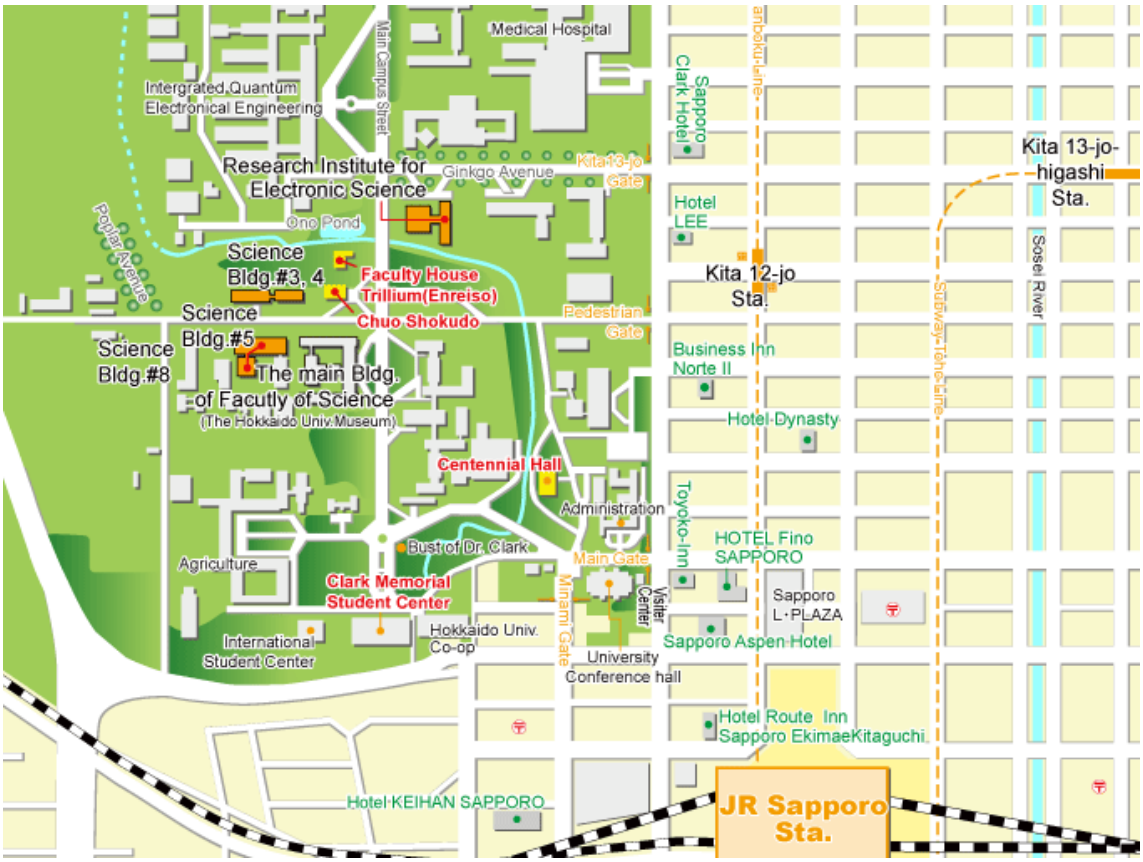
F. A. Grünbaum, L. Velazquez, A. H. Werner, R. F. Werner: Recurrence for discrete time unitary evolutions, Commun. Math. Phys. 320 (2013) 543-569.

J. Bourgain, F. A. Grünbaum, L. Velázquez, J. Wilkening: Quantum recurrence of a subspace and operator-valued Schur functions, arXiv:1302.7286 [quant-ph].

Hiroaki Yoshida (Ochanomizu University, Japan) yoshida@is.ocha.ac.jp

Applications of dissipation formulas of the relative free entropy

We will show that the dissipation formulas of the relative free entropy yield the free logarithmic Sobolev inequality in the case where the potential function is strictly convex. Moreover, combining with the time derivative of the square of the 2-Wasserstein distance, we will give another proof of the free transportation cost inequality by using the optimal mass transport.



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