Version 4

QP38

50th anniversary of Faculty of Science & Technology, Tokyo University of Science

Abstract

Version 4

Special Talk

Luigi Accardi, Centro Vito Volterra, Università di Roma “Tor Vergata”, Italy

Complementary pairs: short review and new examples

Complementary pairs were introduced in the 1982 villa Mondragone conference on quantum probability (QP1) as an attempt to mathematically substantiate Bohr’s distinction between **incompatible** and **complementary** observables in quantum mechanics. In that conference the problem was posed to classify complementary pairs up to the natural equivalence relation among them. After 1982 a huge literature was produced on complementary pairs which, as usual in contemporary science, were re-baptized with different names. However this literature was mostly concentrated on the finite dimensional case. After shortly reviewing the history of the subject, we discuss a new rich class of infinite ב dimensional examples. This talk is based on a joint paper with Yun Gang Lu.

Igor Volovich, Steklov Mathematical Institute, Russia

Quantum dynamics for non-self-adjoint Hamiltonians

The problem of construction a quantum mechanical evolution for the Schrodinger equation with a degenerate Hamiltonian which is a symmetric operator that does not have self-adjoint extensions is considered. Self-adjoint regularization of the Hamiltonian does not lead to a preserving probability limiting evolution for vectors from the Hilbert space but it is used to construct a limiting evolution of states on a C*-algebra of compact operators and on an abelian subalgebra of operators in the Hilbert space. The limiting evolution of the states on the abelian algebra can be presented by the Kraus decomposition with two terms that correspond to the unitary and shift components of Wold's decomposition of an isometric semigroup. Properties of the limiting evolution of the states on the C*-algebras are investigated and it is shown that pure states could evolve into mixed states.

Invited Talk

Irina Aref'eva, Steklov Mathematical Institute, Russia

Holographic control of information and dynamical topology change for composed open quantum systems

We analyze the question of whether the compositeness of system increases the delocalization during equilibration. For this purpose we consider dynamics of open quantum systems composed from separated parts strongly coupled with environment, after a quantum quench corresponding to non-equilibrium heating. We use a holographic description of time evolution of the entangled entropy during nonequilibrium heating process. A general feature of time evolution of the holographic entanglement of composite systems is a non-smooth character of the time evolution.

These systems exhibit a dynamical topology change in the bulk space and also changes of the velocity of the spread of entanglement entropy and number of changes depends on the configuration of the system and especially on the number of the composite parts. The mutual information of two composite systems inherits these discontinuities. We present a detail study of the mutual information for two subsystems one of which is composited on two parts. We found five qualitatively different types of behavior of dynamics of the mutual information and = indicated corresponding regions of parameters of the system.

Miloud Assal, University of Jeddah, Tunisia

New ring Approaches to Solve Class of Partial Differential Equations

In this paper we introduce a new ring R of ponderation functions and we study a class of modules over R and prove that Laplace transform and Fourier transform generate some free modules over the ring R. Moreover we characterize the projective modules and simple modules and we prove that the socle of this ring is not an injective module. As an application we use the ring properies to give a new methode to solve equations of the

form Div(Xf)= g in several variables. Furthermore, we give a general solution of the Cauchy-Euler Equations in high dimensions.

Keywords: Ring , Cauchy-Euler differential Equations.

References:

[1] Assal M., Zeyada N, "New ring of a class of Bessel integral operators. Integral Transforms Spec Funct. 2016;27(8):611-619..

[2] Atiyah, MF, Macdonald, IG. "Introduction to Commutative Algebra". Westview Press: New York; 1969.

[3] T. Pierce RS. "Associative Algebras". Graduate Texts in Mathematics

Roberto Quezada Batalla, Universidad Autónoma Metropolitana-Iztapalapa, Mexico

On Invariant States of Weak Coupling Limit Type Markov Generators: Quantum Transport and Photosynthesis

We will discuss the structure of invariant states of some weak coupling limit type Markov generators. In particular we will report some recent results concerning two generators (of Arefeva-Kozyrev-Volovich [1] and Kozyrev-Volovich [2], respectively), modeling excitation energy transport in quantum many-particle systems and photosynthesis.

References:

[1] Aref'eva, Y., Volovich, I. and Kozyrev, S. 2015. Stochastic Limit Method and Interference in Quantum Many-particles Systems. Theoretical and Mathematical Physics, 183 (3) (2015) 782-799.

[2] Kozyrev S. and Volovich I., Dark states in quantum photosynthesis, arXiv:1603.07182v1 [physics.bio-ph] (2016).

Roman Belavkin, Middlesex University, United Kingdom

Asymmetric Topology of Quantum Information

Quantum states are positive trace one operators that are elements of a Banach space with the norm of absolute convergence (i.e. l_1 or L_1). The comparison of states, however, is often done not in terms of the corresponding metric (distance in variation), but in terms

of an information divergence, such as the Araki-Umegaki relative information - the quantum analogue of the Kullback-Leibler (KL) divergence. These information distances are not symmetric and define unbalanced neighbourhoods. Here we define asymmetric norm and a quasimetric using such information neighbourhoods and study some of the properties of the induced topology. Despite some similarities with the theory of Orlicz spaces, many standard results from the theory of Banach spaces do not hold due to the asymmetry. We discuss separation axioms, completeness and separability of the information topology.

Rajarama Bhat, Indian Statistical Institure, Bangalore Center, India

Two states

D. Bures defined a metric on states of a C*-algebra as the infimum of the distance between associated vectors in common GNS representations. We take a different approach by looking at the completely bounded distance between relevant joint representations. The notion has natural extension to unital completely positive maps. The study yields new understanding of GNS representations of states and in particular provides a new formula for Bures metric. This is a joint work with Mithun Mukherjee.

Jorge Bolanos, Universidad Autónoma Metropolitana-Iztapalapa, Mexico

Block representation and some spectral properties of circulant QMS

In this talk I will describe how some properties of the classical circulant generator extend to the corresponding circulant dilation, focusing in particular on spectral decompositions, invariant states. These properties allow us to have a clear picture of the asymptotic properties of the evolution (ergodicity), included decoherence.

Louis Chen, National University of Singapore, Singapore

Stein's method and many interacting worlds in quantum mechanics

Hall, Deckert and Wiseman (Phys. Rev. X, 2014) proposed a many-interacting-worlds

(MIW) theory for interpreting quantum mechanics. In this theory, quantum theory can be understood as the continuum limit of a deterministic theory in which there is a large, but finite, number of interacting classical "worlds". Here, a world means an entire universe with well-defined properties, determined by the classical configuration of its particles and fields. Hall et al proposed a MIW harmonic oscillator model for N one-dimensional worlds. They used an energy minimization argument to derive a recursion equation for the ground state locations of the N worlds viewed as particles, and conjectured that the empirical distribution of these locations has a Gaussian limit as N tends to infinity.

In this talk, we use Stein's method to prove the Gaussian limit and obtain optimal rates of convergence. We will also discuss how Stein's method can be used to prove convergence to the two-sided Maxwell distribution and obtain rates of convergence for the empirical distribution of the particle locations in the first energy level above the ground state.

This talk is based on joint work with Le Van Thanh (preprint, 2017) and work by Mckeague and others (Ann. Appl. Probab, 2016 and Bernoulli, 2017).

Dariusz Chruscinski, Nicholaus Copernicus University, Poland

On memory kernel master equations

I present sufficient conditions for the memory-kernel governing nonlocal master equation which guarantee a legitimate (completely positive and trace-preserving) dynamical map. It turns out that these conditions provide natural parametrizations of the dynamical map being a generalization of the Markovian semigroup. This parametrization is defined by the so-called legitimate pair monotonic quantum operation and completely positive map and it is shown that such a class of maps covers almost all known examples from the Markovian semigroup, the semi-Markov evolution, up to collision models and their generalization.

Vitonofrio Crismale, University of Bari, Italy

Wick order and spreadable stochastic processes on the monotone *-algebra

In the talk we first present a Hamel basis for the monotone *-algebra mainly composed by Wick ordered words. Then we show how to apply such a result to investigate some distributional symmetries like spreadability and exchangeability for monotone stochastic processes. We get that spreadability comes from a monoid action implementing a dissipative dynamics, and moreover determine the structure of spreadable and exchangeable monotone stochastic processes using their correspondence with spreading invariant and symmetric monotone states, respectively. This is joint work with F. Fidaleo and M. E. Griseta.

Ameur Dhahri, Chungbuk National University, Korea

C*-non-linear second quantization

We introduce a non linear polynomial extension of the 1-mode Heisenberg group and the corresponding Fock and Weyl representations. The transition from the 1-mode case to the current algebra level (second quantization) can be done at Lie algebra level. However the existence of the Fock representation for the above Lie algebra is equivalent to the infinite divisibility problem. A way to bypass the difficulties of constructing a (non trivial) Hilbert space representation is to try and construct directly a C*-algebra representation and then to look for its Hilbert space representations. In usual (linear) quantization, this corresponds to the construction of the Weyl C*-algebra. In a joint work with Luigi Accardi, we produced such a construction for the above mentioned polynomial extension of the Weyl C*-algebra. Moreover, we proved that the corresponding family of Fock states, defined on the inductive family of C*-algebras, is projective if and only if n=1.

Franco Fagnola, Politecnico di Milano, Italy

On the structure of quantum Markov semigroups

We discuss the relationships between the decoherence-free subalgebra and the structure of the fixed point subalgebra of a quantum Markov semigroup on B(h) with a faithful normal invariant state. We show that atomicity of the decoherence-free subalgebra is equivalent to typical splittings of B(h) into the a subalgebra where maps of the semigroup acts as endomorphisms and a remainder space. Moreover, we characterize the set of reversible states.

References.

[1] J. Deschamps, F. Fagnola, E. Sasso and V. Umanita. Structure of Uniformly Continuous Quantum Markov Semigroups. Rev. Math. Phys. 28 (2016), 1650003-1 -- 1650003-32.

[2] F. Fagnola, E. Sasso and V. Umanita. Relationships between the decoherence-free algebra and the set of fixed points. In preparation

Francesco Fidaleo, University of Rome "Tor Vergata", Italy

Type III representations and Modular Spectral Triples for the noncommutative torus

For any irrational rotation number a, it is well known that the noncommutative torus A_a must have representations such that the generated von Neumann algebra is of type III. Unfortunately, at the knowledge of the authors no of such representations of these kind is explicitly exhibited and investigated in detail, up to now. We also note that no example of Spectral Triple associated to type III representations whose twist of the involved Dirac Operator and the corresponding twisted derivation arises from the Tomita Modular Operator is explicitly known at all.

In the present paper, for any Liouville number a we exhibit plenty of type II_∞ and type III_λ, λ in [0,1], factor representations, and correspondingly, Modular Spectral Triples whose twisting of the Dirac Operator and the associated commutator is obtained by the underlying nontrivial modular structure.

The method developed in the present paper can be generalised to CCR algebras based on a locally compact abelian group equipped with a symplectic form.

Uwe Franz, University of Bourgogne Franche-Comté, France

Lévy processes on the Lorentz-Lie algebra

Lévy processes on real Lie algebras (in the sense of Sch"urmann) are studied. It is known that if we consider simple Lie algebras, then the most interesting examples are defined on the families su(n,1) and so(n,1). In previous work in collaboration with Luigi Accardi et al we concentrated on su(1,1)=so(2,1)=sl(2,R). In this talk we will look at new results on so(3,1)=sl(2,C). This is based on joint work with Ameur Dhahri.

Malte Gerhold, University Greifswald, Germany

Notions of independence for multifaced random variables

In non-commutative probability there are several well known notions of independence. In 2003, Muraki's classification, which states that there are exactly five independences coming from universal (natural) products, seemingly settled the question of what independences can be considered. But after Voiculescu's invention of bi-free independence in 2014, the question came up again. The key idea that allows to define a new notion of independence with all the features of the universal independences that appear in Muraki's classification is to consider "two-faced" random variables. We define and explore several new examples of independences for multifaced random variables and describe their respective standard Gaussian laws (realized as distributions of certain Fock space operators) in a combinatorial manner.

Debashish Goswami, Indian Statistical Institute, Kolkata, India

Levi-civita connection in Noncommutative Geometry

I discuss a new formulation of Levi- civita connection in noncommutative geometry a la Connes and prove existence and uniqueness result for such connection in this context for a large class of noncommutative manifolds.
Joint work with J. Bhowmick and S. Joardar.

Matteo Gregoratti, Politecnico di Milano, Italy

Measurement Uncertainty Relations for Position and Momentum: Relative Entropy Formulation

Heisenberg's uncertainty principle has recently led to general measurement uncertainty relations for quantum systems: incompatible observables can be measured jointly or in sequence only with some unavoidable approximation, which can be quantified in various ways. The relative entropy is the natural theoretical quantifier of the information loss when a 'true' probability distribution is replaced by an approximating one.

In this talk, we provide a lower bound for the amount of information that is lost by replacing the distributions of the sharp position and momentum observables, as they could be obtained with two separate experiments, by the marginals of any smeared joint measurement. The bound is obtained by introducing an entropic error function, and optimizing it over a suitable class of covariant approximate joint measurements. We fully exploit two cases of target observables: (1) n-dimensional position and momentum vectors; (2) two components of position and momentum along different directions. In (1), we connect the quantum bound to the dimension n; in (2), going from parallel to orthogonal directions, we show the transition from highly incompatible observables to compatible ones. For simplicity, we develop the theory only for Gaussian states and measurements.

This is joint work with Alberto Barchielli and Alessandro Toigo.

Rachid El Harti, University Hassan First, Morocco

Hilbert Modules and Quantum probability

Satoshi Iriyama, Tokyo University of Science, Japan

A Combined Quantum Algorithm and Its Computational Complexity

A quantum algorithm for the general search problem is proposed by Ohya et al. in 2015. An NP-hard problem can be solved in polynomial steps with high probability by the quantum algorithm which implicates multiple quantum computation. Each quantum algorithm amplifies the success probability using the special dynamics, so called the Chaos amplifier, which is defined by the logistic map. In 2017, we showed that the Chaos amplifier and more general amplification process can be represented by the GKSL master equation in two-qubit system. In this study, we explain our notion of combined quantum algorithm, and discuss on its computational complexity for difficult problem.

Andrzej Jamiolkowski, Nicholaus Copernicus University, Poland

On Partial Commutativity of Kraus and Jump Operators

Simplified models of complicated systems offer oportunities for developing intuition as well as, in some cases, providing analytic solutions. In descriptions of quantum state manipulations by laser pulses the relevant equations can become relativly complicated.

Our aim in this presentation is to apply some algebraic methods to describe decompositions of the Kraus (in case of channels) or jump (in case of master equations) operators into block forms and simplification of corresponding evolutions.

Properties of largest (maximal) subspaces on which Kraus and jump operators commute are presented and discussed.

Un Cig Ji, Chungbuk National University, Korea

Anticipating Quantum Stochastic Integrals

Based on the quantum white noise theory, we review the notion of quantum white noise derivatives and as an application, we introduce anticipating quantum stochastic integrals of non-adapted quantum stochastic processes against with the annihilation, creation and conservation processes. The new anticipating quantum stochastic integrals is represented in terms of quantum white noise derivatives and considered as a quantum extension of classical Stratonovich integral. Then we discuss basic properties of the anticipating quantum stochastic integrals.

Soumalya Joardar, J.N.Centre for Advanced Scientific Research, India

Weyl algebra, Hyperbolic space and Noncommutative Hyperbolic plane

This is a talk based on an ongoing joint work with Professor K. B. Sinha. We propose a Weyl system represented on the Hilbert space $L^2(H^2; d\mu)$ where H^2 is the Hyperbolic plane and $d\mu$ is the corresponding hyperbolic measure. We give four canonical derivations on the algebra and using them propose a Lindbladian which would enable us

to study geometric properties of the Weyl algebra.

Andrei Khrennikov, Linnaeus University, Sweden

Quantum-like models of cognitive and social processes. Social laser in action: from color revolutions to Brexit and election of Donald Trump

We start with the general overview of applications of quantum probability and information outside of physics, to psychology, cognition, economics, finances, social and political sciences. Then we move to quantum probabilistic modeling of decision making. The use of quantum probability resolves the main paradoxes of DM such as Ellsberg and Machina paradoxes. Then we consider a more speculative, but very important quantum-like model: Stimulated Amplification of Social Actions (SASA) - a kind of social laser. The main part of the talk is devoted to analysis of assumptions on the information field and human gain-medium providing the possibility of creation of The model and its analysis are based on the formalism of quantum thermodynamics and field theory (applied outside of physics). SASA is the hot topic in socio-political studies. Evidence of such amplifications is rapidly accumulating, from color revolutions to such democratically structured protest actions as Brexit and the recent election of Donald Trump as the president of USA. These studies are characterized by diversity of opinions and conclusions. The presented quantum-like model provides the consistent operational model of this complex socio-political phenomenon. This is the conceptual talk aimed to present in the compact form the basic assumptions for creation of social lasers and attract attention of other researchers (both from physics and socio-political science) to the problem of modeling of SASA.

References

[1] M. Asano, A. Khrennikov, M. Ohya, Y. Tanaka, I.Yamato, ¥textit{Quantum Adaptivity in Biology: from Genetics to Cognition.}
Springer, Heidelberg-Berlin-New York, 2015.

[2] A. Khrennikov, ``Social laser:'' action amplification by stimulated emission of social energy. *Phil. Trans. Royal Soc.*, 374, N 2054, 20150094 (2016).

Yoshifumi Kimura, Nagoya University, Japan

Vortex reconnections in quantum turbulence

Vortex reconnection is a fundamental process in both classical and quantum turbulence. In this talk, after reviewing the relation between the basic equations for the quantum turbulence (Gross-Pitaevskii equation) and for the fluid motion (Euler equation), we present a simple model for vortex reconnection under Biot-Savart evolution. Using this model, some mechanism of vortex reconnection is investigated.

Takahi Matsuoka, Suwa Tokyo University of Science, Japan

On Quantum Conditional Entropy

We discuss the correlations on classical and quantum system form the information theoretical points of view. There exists an essential difference between such two types of correlation. How can we understand such difference? Then some entropy criteria were introduced and it was shown that some of them are useful to measure the difference between the classical and quantum system. In this talk we focus the two types of quantum entropy, so called the quantum conditional entropy and the quantum mutual entropy. Such entropies have several different kinds of definition given by several authors. We will review the definitions and discuss their relations.

Zouhair Mouayn, Sultan Moulay Slimane University, Morocco

Analysis of photon-count number distributions associated with higher Landau levels

By constructing generalized coherent states, to each Euclidean Landau level corresponds a generalized Poisson distribution and to each hyperbolic Landau level is attached a generalized negative binomial distribution. For these probability distributions, we write atomic decompositions and we discuss the nonclassical nature of the associated coherent states. We derive Lévy-Khintchine-type representations of their characteristic functions when the latters do not vanish and deduce that they are quasi-infinitely divisible except for lowest Landau levels. By considering the total variation of the obtained quasi-Lévy measures, we introduce new infinitely divisible distributions.

Farrukh Mukhamedov, United Arab Emirates University, UAE

Quantum Markov Chain associated with XY-Ising model on the Cayley tree

In the present work we consider backward and forward Quantum Markov Chains (QMC) associated with XY-Ising model on the Cayley tree of order two. We construct finite volumes states with boundary conditions, and define QMC as a weak limit of those states which depends on the boundary conditions. We prove that the limit state is a unique QMC associated with such a model, this means the QMC does not depend on the boundary conditions. We also prove that backward QMC has clustering property which yields that the associated von Neumann algebra (via GNS-construction) is a factor. Moreover, we observe the relation between backward and forward QMCs. The present work has been carried out jointly with Soueidy El Gheteb.

Habib Ouerdiane, University of Tunis El Manar, Tunisia

Symbols of Generalized White Noise Operators and Applications

In this talk, we develop the theory of operators defined on infinite dimensional holomorphic functions. Then we give a characterization theorem between this class of operators and their symbols. As application we give an explicit solution of some linear quantum white noise differential equations by applying the convolution calculus on a suitable distribution spaces. In particular we obtain an integral representation for the solution of the quantum heat equation.

Nazife Erkursun Ozcan (Hacettepe University, Turkey) and
Farrukh Mukhamedov (United Arab Emirates University, UAE)

Perturbation Bounds of Markov Semigroups on Abstract State Spaces

In this talk, we establish the uniform asymptotical stability for Markov semigroups in terms of the Dobrushin's ergodicity coefficient. In this way, we obtain a linear relation between the stability of the semigroup and the sensitivity of its fixed point with respect to perturbations of Markov operators. Moreover, we also obtain perturbation bounds for the time averages of the uniform asymptotically stable semigroups. Furthermore, we prove the equivalence of uniform and weak ergodicities of the time averages Markov operators in terms of the ergodicity coefficient, which is a new insight to this topic. Moreover, the unique ergodicity of semigroups is studied in terms of weighted averages. The obtained results are new even in the quantum setting.

This work is the joint work with Prof. Dr. Farrukh Mukhamedov, United Arab Emirates University Department of Mathematical Sciences.

Nicolas Privault, Nanyang Technological University, Singapore

De Rham-Hodge decomposition and vanishing of harmonic forms by derivation operators on the Poisson space

We construct differential forms of all orders and a covariant derivative together with its adjoint on the probability space of a standard Poisson process, using derivation operators. In this framewok we derive a de Rham-HodgeKodaira decomposition as well as Weitzenb¨ock and Clark-Ocone formulae for random differential forms. As in the Wiener space setting, this construction provides two distinct approaches to the vanishing of harmonic differential forms.

Habib Rebei, Qassim University, Kingdom of Saudi Arabia

C*-quadratic quantization

In the first part of the talk we introduce a new parametrization for the manifold underlying quadratic analogue of the usual Heisenberg group introduced in [10] which makes the composition law much more transparent. In the second part of the paper the new coordinates are used to construct an inductive system of C*-algebras each of which is isomorphic to a finite tensor product of copies of the one-mode quadratic Weyl algebra.

We prove that the inductive limit C*-algebra is factorizable and has a natural localization given by a family of C*-sub-algebras each of which is localized on a bounded Borel subset of R. Moreover, we prove that the family of quadratic analogues of the Fock states, dened on the inductive family of C*-algebras, is projective hence it defines a unique state on the limit C*-algebra.

Wilfredo Urbina Romero, Roosevelt University Chicago, U.S.A.

Topics on Gaussian harmonic analysis on Lp variables spaces.
<http://www.ams.org/amsmtgs/2242_abstracts/1129-42-482.pdf>

This is a work in progress. We study the boundedness of the Gaussian Hardy-Littlewood maximal function (with generalizations to general probability measures) and the boundedness of the Ornstein-Uhlenbeck semigroup in variable Lp- spaces. It turns out that, different from the classical case, in this context the Ornstein-Uhlenbeck semigroup is not a contractive semigroup and therefore is not hyper-contractive either. Joint work with Ebne Ebner Pineda and Jorge Moreno? from Universidad Centro-Occidental, Lisandro Alvarado Facultad de Ciencias, Departamento de Matematicas, Barquisimeto, Venezuela

Emanuela Sasso, Genova University, Italy

Characterization of decoherence-free subsystems

We compare the notion of decoherence-free subsystems with the structure of the decoherence-free subalgebra for a uniformly continuous Quantum Markov semigroup on B(h). We show that, the existence of a faithful normal invariant state and the atomicity of the decoherence-free sub algebra, induce a decomposition of h that allows us to identify every decoherence-free subsystem.
It is a joint work with Veronica Umanit.

Kimiaki Saito, Meijo University, Japan

Powers of white noise associated with the product of distributions

In this talk we introduce a new locally convex space of distributions, in which we have the product of any distributions as a series expansion. Then we discuss higher powers of the complex white noise on the space consisting of distributions without any renormalization. We also extend the Lévy and Voltera Laplacians to operators on a locally convex space taking the completion of the set of all distribution-coefficient polynomials on distributions with respect to some topology, and give an integral expression of the Lévy Laplacian and an infinite dimensional Brownian motion generated by the Lévy Laplacian with a divergent part as a distribution. Based on those results, we obtain white noise distribution-valued stochastic differential equations, for the delta distribution centered at the infinite dimensional Brownian motion and also a sum of delta distributions centered at one dimensional Brownian motions.

Gniewomir Sarbicki, Nicholaus Copernicus University, Poland

Quantum environment probing

Assume, that we are able to couple a probing system to an unknown environment in two different temperatures and for both perform a process tomography for a fixed time of evolution. For the resulting pair of channels, we calculate the $¥alpha$-fidelities. We derive an inequality between this data and the partition function of environment. This is a necessary condition, which allows us to exclude some ranges of spectra of environment. The method does not dependent on the dimensionality and Hamiltonian of the probing system, neither on the form of the interaction term.

Rene Schott, University of Lorraine , France

On stochastic calculus with respect to q-Brownian motion

We pursue the investigations initiated by Donati-Martin regarding stochastic calculus with respect to the q-Brownian motion, and essentially extend the previous results along two directions:

(I) We develop a robust L^{∞}-integration theory based on rough-paths principles and apply it to the study of q-Bm-driven differential equations;

(II) We provide a comprehensive description of the multiplication properties in the q-Wiener chaos.

Our presentation follows a probabilistic pattern, in the sense that it only leans on the law of the process and not on its particular construction. Besides, our formulation puts the stress on the rich combinatorics behind non-commutative processes, in the spirit of the machinery developed by Nica and Speicher.

Joint work with Aurélien Deya (Institut Elie Cartan, University of Lorraine, France).

Si Si, Aichi Prefectural University, Yangon University, Myanmar

A short view on Professor Takeyuki Hida's work

Aurel I. Stan, The Ohio State University at Marion, U.S.A.

A Holder inequality for norms of Gamma Wick products

We present first an integral representation, for the Wick product generated by a Gamma distribution with mean greater than 1/2. In this integral representation, the factors of the Wick product are first made smoother by the application of some second quantization operators. Finally, using this integral representation, we prove a Holder inequality for norms of Gamma Wick products.

Tadashi Toyoda and Maho Fujita, Tokai University, Japan

Quantum field theory and nanotechnology

Quantum field theory was developed in the study of particle physics, and is now intensively used in many areas such as statistical physics, condensed matter physics and information theory. On the other hand, recent explosive progress in nanotechnology requires deeper understanding of new phenomena in nanomaterials such as graphene and carbon nanotube. In this lecture we illustrate the powerfulness of quantum field theory to understand the fundamental mechanism of some striking properties discovered in graphene which is expected to play an indispensable significant role in nanotechnology.

Noboru Watanabe, Tokyo University of Science, Japan

Note on Transmitted Complexity for Quantum Dynamical Systems

In 1989, Ohya propose a new concept, so-called Information Dynamics (ID), to investigate complex systems according to two kinds of view points. One is the dynamics of state change and another is measure of complexity. In ID, two complexities C^S and T^S are introduced. C^S is a measure for complexity of system itself, and T^S is a measure for dynamical change of states, which is called a transmitted complexity. An example of these complexities of ID is entropy for information transmission processes. The study of complexity is strongly related to the study of entropy theory for classical and quantum systems. The quantum entropy was introduced by von Neumann around 1932, which describes the amount of information of the quantum state itself. It was extended by Ohya for C*-systems before CNT entropy. The quantum relative entropy was first defined by Umegaki for σ-finite von Neumann algebras, which was extended by Araki and Uhlmann for general von Neumann algebras and *-algebras, respectively. By introducing a new notion, the so-called compound state, in 1983 Ohya succeeded to formulate the mutual entropy in a complete quantum mechanical system (i.e., input state, output state and channel are all quantum mechanical) describing the amount of information correctly transmitted through the quantum channel.

In this talk, we briefly review the complexity for quantum dynamical systems. We introduce transmitted complexity by means of entropy functionals in order to treat the transmission processes consistently. We apply the general frames of quantum entropy for quantum dynamical systems. Finally, we define a transmitted complexity (mutual entropy) by means of the generalized AOW entropy, and we prove the fundamental inequalities of the transmitted complexity for the quantum dynamical systems.

References

[1] L. Accardi and M. Ohya, Compound channels, transition expectation and liftings,

Appl. Math, Optim., 39, 33-59 (1999).
[2] H. Araki, Relative entropy for states of von Neumann algebras, Publ. RIMS Kyoto Univ. 11, 809–833, (1976).
[3] J. von Neumann, Die Mathematischen Grundlagen der Quantenmechanik, Springer-Berlin, 1932.
[4] M. Ohya, On compound state and mutual information in quantum information theory, IEEE Trans. Information Theory, 29, 770-774 (1983).
[5] M. Ohya, Note on quantum probability, L. Nuovo Cimento, 38, 402-404, (1983).
[6] M. Ohya, Some aspects of quantum information theory and their applications to irreversible processes, Rep. Math. Phys., 27, 19-47 (1989).
[7] M. Ohya and D. Petz, Quantum Entropy and its Use, Springer, Berlin, 1993.
[8] M. Ohya and I. Volovich, Mathematical Foundations of Quantum Information and Computation and Its Applications to Nano- and Bio-systems, Theoretical and Mathematical Physics, Springer, 2011.
[9] M. Ohya and N. Watanabe, A new treatment of communication processes with Gaussian channels, Japan Journal on Applied Mathematics, 3, 197-206 (1986).
[10] M. Ohya and N. Watanabe, Construction and analysis of a mathematical model in quantum communication processes, Electronics and Communications in Japan, Part 1, 68, No.2, 29-34 (1985).
[11] H. Umegaki, Conditional expectations in an operator algebra IV (entropy and information), Kodai Math. Sem. Rep., 14, 59-85 (1962).
[12] A. Uhlmann, Relative entropy and the Wigner-Yanase-Dyson-Lieb concavity in interpolation theory, Commun. Math. Phys., 54, 21～32, (1977).
[13] N. Watanabe, Some Aspects of Complexities for Quantum Processes, Open Systems and Information Dynamics, 16, No.2&3, 293-304, 2009.

Janusz Wysoczanski, Wroclaw University, Poland

Poisson type limit theorems for bm-independence

We shall present the limit theorems of Poisson type for bm-independent noncommutative random variables, indexed by some positive symmetric cones. These include the cones in euclidian spaces, the Lorentz cones and the positive definite real symmetric matrices. For each of the cones particular problems to solve are: the formulation of the theorem and the definition of the limit as the index tends to infinity. The results involve combinatorial description of bm-ordered partitions and the volume characteristic sequences related to each of the cones.

Minoru Yoshida, Kanagawa University, Japan

Conditional distribution of a random variable, conditioned by Hida distributions, on Euclidean quantum fields.

For each $\kappa \in C_0^\infty\left(\mathrm{R}^d \to \mathrm{R}\right)$, $d = 2$ or $d = 3$, we consider the conditional distribution of the random variable $\kappa(\phi)$ on the 2-dimensional free field, the 3-dimensional free field, the $P(\Phi)_2$ Euclidean field and Φ_3^4 Euclidean field, conditioned by the outside fields of the support of κ, which are characterized by Hida distribution.

Poster Presentation

1. **Philipp Varso,** University Greifswald, Germany

   On general universal independences

2. **Monika Malczak,** University Greifswald, Germany

   Levy processes on braided =-bialgebras

3. **Yujiro Igari, Noboru Watanabe,** Tokyo University of Science, Japan

   On comparison of quantum mutual entropy type measures

4. **Shun Kato, Noboru Watanabe,** Tokyo University of Science, Japan

   On construction of quantum teleportation by majaring of quantum orthogonal states generated by coherent states

5. **Takumi Makiwara and Noboru Watanabe,** Tokyo University of Science, Japan

   On Mathematical treatment of Information transmission for Gaussian Communication Process based on Quantum Communication Theory

6. **Kyouhei Ohmura and Noboru Watanabe,** Tokyo University of Science, Japan

   Formulations of Quantum Dynamical Mutual Entropy based on AOW Entropy