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OPERATOR ALGEBRAS AND QUANTUM PHYSICS

Satellite Conference to the
XVIII International Congress on Mathematical Physics

São Paulo, Brazil – 17 to 23 July, 2015

http://icmp2015.satellite.ime.usp.br/

Universidade de São Paulo
Instituto de Física & Instituto de Matemática e Estatística

Auditório Abrahão de Moraes, IFUSP

Conference Programme

Schedule

	17th. July Fri	18th. July Sat	19th. July Sun	20th. July Mon	21st. July Tue	22nd. July Wed	23th. July Thu
09:00–10:20	Welcome Wreszinski*	Fredenhagen	—	Buchholz	Klein	Nachtergaele	Dimock
10:20–10:40	Wreszinski	*Coffee Break*	—	*Coffee Break*	*Coffee Break*	*Coffee Break*	*Coffee Break*
10:40–12:00	Merkli	Bru	—	Salmhofer	Dybalski	Lechner	Costin
12:00–14:00	*Lunch*	—	—	*Lunch*	*Lunch*	*Lunch*	—
14:00–15:20	Brunetti	—	—	da Veiga	Verch	del Rio	—
15:20–15:40	*Coffee Break*	—	—	*Coffee Break*	*Coffee Break*	*Coffee Break*	—
15:40–17:00	Alazzawi	—	—	Dappiaggi	Ben Geloun	Tanimoto	—
17:00–17:30	Posters	—	—	Presentation**	Rejzner †	Posters	—

The time for each talk is 80 minutes, including 10 minutes for questions.

* W. Wreszinski's talk starts at 9:20.

** Presentation of the Jorge André Swieca Group.

† Contributed talk (30 min.).

Talks

Sabina Alazzawi

Technische Universität München

"Rigorous Construction of Weakly Interacting Quantum Field Theories"

Summary: *"Within the framework of algebraic quantum field theory we discuss a rigorous construction of $1+1$-dimensional weakly interacting models. Our approach is based on a factorizing S-matrix rather than a Lagrangian and allows for the construction of integrable, nontrivial models apart from perturbation theory and renormalization. The considered particle spectrum involves an arbitrary number of massive particle species which transform under a global gauge group. Starting from known wedge-local auxiliary fields, the existence of local theories is shown under certain conditions by means of operator algebraic techniques. Our construction gives rise to a large class of models. Among them are the prominent $O(N)$-invariant nonlinear σ-models, now accessible in a non-perturbative setting".*

Joseph Ben Geloun

Max Planck Institute for Gravitational Physics, Albert Einstein Institute

"Tensor Models and Renormalization"

Summary: *"The Tensor Models proposal for Quantum Gravity will be reviewed. I will then discuss a way to formulate these statistical models in a quantum field theoretical setting and discuss, the way to renormalize these tensorial field theories".*

Jean-Bernard Bru

Universidad del País Vasco and Basque Center for Applied Mathematics

"Spins and Fermi Systems With Long-Range Interactions"

Summary: *"We define a Banach space M of models for fermions or quantum spins in the lattice with long range interactions and make explicit the structure of (generalized) equilibrium states for any $m \in M$. In particular, we give a first answer to an old open problem in mathematical physics - first addressed by Ginibre in 1968 within a different context - about the validity of the so-called Bogoliubov approximation on the level of states. Depending on the model $m \in M$, our method provides a systematic way to study all its correlation functions at equilibrium and can thus be used to analyze the physics of long range interactions. Furthermore, we show that the thermodynamics of long range models $m \in M$ is governed by the non-cooperative equilibria of a zero-sum game, called here thermodynamic game".*

Romeo Brunetti

Università degli Studi di Trento

"Perturbative Quantum Gravity as a Generally Covariant Theory"

Summary: *"Following the lead of recent results in pAQFT we develop perturbative quantum gravity as a locally covariant quantum field theory, in particular as a background independent theory".*

Detlev Buchholz

Universität Göttingen

"Superpositions, Transition Probabilities and Primitive Observables in Infinite Quantum Systems"

Summary: *"Concepts, familiar from pure states in quantum mechanics, such as 'superposition' and 'transition probability', are shown to be also meaningful for generic states in infinite systems, described by funnels of type I algebras. In the physically important case of states of Connes-von Neumann type III_1, these concepts also have a physically significant operational interpretation in terms of primitive observables". (Joint work with Erling Størmer).*

Ovidiu Costin

Ohio State University, Columbus

"Nonperturbative Techniques in Quantum Systems Subject to Time Periodic Potentials"

Summary: *"I will describe new nonpertubative methods that we have developed to analyze the behavior of quantum mechanical systems in time periodic potentials. I will prove, as an application, the ionization of Hydrogen atoms in time harmonic, compactly supported, radially symmetric external fields of arbitrary size, and calculate the ionization rate".*

Claudio Dappiaggi

Università degli Studi di Pavia

"Constructing Isometry Invariant Hadamard States via a Novel Deformation Argument"

Summary: *"Existence of Hadamard states for a free field theory on a globally hyperbolic spacetime is proven via an old deformation argument, proposed by Fulling, Narkowich and Wald in the eighties. The main deficiency of this scheme is the complete loss of any control on the invariance of the state under the action of the background isometries. In order to account for them, one needs to resort to specific construction schemes which are often valid for a given free field with a fixed value of the mass and, if present, of the coupling to scalar curvature. Via an extended version of the Møller operator, we show that, these isometry invariant Hadamard states can be deformed to Hadamard states for any value of the mass and of the coupling to scalar curvature. Furthermore the invariance under any spacelike isometry is preserved, while, for the timelike ones, a kind of adiabatic procedure is necessary". (Joint work with Nicolò Drago (U. of Genoa) - arXiv:1506.09122 [math-ph]).*

Jonathan Dimock

State University of New York, Buffalo

"Renormalization Group for Gauge Theories"

Summary: *"Balaban has developed a rigorous renormalization group technique that is especially well-suited to ultraviolet problems in gauge quantum field theory. In this talk we first outline the method for the simpler case of a scalar field with a quartic self interaction in a three dimension Euclidean space-time. Then we consider the extension to a charged scalar field interacting with an abelian gauge field (i.e., scalar quantum electrodynamics) still in three dimensions. An attractive feature of the current version of the method is that renormalization can be carried out without reference to perturbation theory".*

Wojciech Dybalski

Technische Universität München

"Compton Scattering in the Buchholz-Roberts Framework of Relativistic QED"

Summary: *"Starting from the fact that each observer has direct access only to its future light cone V, Buchholz and Roberts proposed a novel approach to infrared problems. In particular these authors identified certain tractable classes of states on the algebra of observables localized in V ('simple charge classes') with good localization properties. We discuss scattering of one electron and photons in a simple charge class, indicate simplifications in comparison with more traditional approaches and point out some remaining open problems". (Joint work with Sabina Alazzawi).*

Klaus Fredenhagen

Universität Hamburg

"Approaching Quantum Gravity via Algebraic Quantum Field Theory: How Far Are We?" (based on joint work with Romeo Brunetti and Katarzyna Rejzner).

Summary: *"Algebraic Quantum Field Theory is in may respects the conceptionally most satisfactory framework for fundamental physics. The distinguished role of classical spacetime in the standard fornulation of Algebraic Quantum Field Theory, however, is an obstruction for incorporating quantized degrees of freedom of the metric field as required for Quantum Gravity. Based on a perturbative construction of Quantum Gravity by the methods of perturbative Algebraic Quantum Field Theory we discuss how far these problems can be overcome".*

Abel Klein

University of California, Irvine

"An Eigensystem Approach to Anderson Localization"

Summary: *"We introduce a new approach for proving localization (pure point spectrum with exponentially decaying eigenfunctions, dynamical localization) for the Anderson model at high disorder. In contrast to the usual strategy, we do not study finite volume Green's functions. Instead, we perform a multiscale analysis based on finite volume eigensystems, establishing localization of finite volume eigenfunctions with high probability". (Joint work with A. Elgart).*

Gandalf Lechner

Cardiff University

"Endomorphisms of Standard Spaces and the S-Matrix"

Summary: *"In low-dimensional QFT, the semigroup of symmetric inner functions on the upper half plane appears in two different roles: On the one hand, these functions describe elastic two-particle scattering of massive particles and waves, and on the other hand, these functions are in one to one correspondence with endomorphisms of irreducible so-called standard pairs, describing the modular structure of observables localized in a half-line or wedge. In this talk we report on a recent construction comparing these two aspects".*

Marco Merkli

Memorial University of Newfoundland

"Dynamics of the Spin-Boson Model for Arbitrary Coupling Strength"

Summary: *"We show that the spin-boson system approaches its equilibrium state for large times, at arbitrary strengths of the coupling between the spin and the boson heat bath, provided the tunneling matrix element is small enough. Over long time spans, the relaxation to equilibrium follows an exponential decay law, with a rate that had first been found heuristically by Leggett et al. Our approach is based on the spectral analysis of the generator of dynamics. As complex deformation techniques fail in the regime of large couplings, we develop a Mourre theory to tackle this problem". The talk is based on collaborations with Martin Könenberg and Haifeng Song.*

Bruno Nachtergaele

University of California, Davis

"New Developments in Frustration-Free Quantum Spin Systems"

Summary: *"A quantum spin model is called frustration-free, if the expectation of every term in the Hamiltonian is minimized in a ground state. This property is shared by a wide range of models for which non-trivial interesting results have been proved in recent years. The frustration-freeness implies concrete structural properties of the ground states, in particular of its entanglement structure. Techniques from operator algebras, functional analysis, and quantum information theory have been successfully applied to study the ground states and low-lying excitations of frustration- free models and perturbations of them. We will review some of the recent advances on this class of models".*

Katarzyna Rejzner

University of York

"Locally Covariant QFT and Perspectives on Quantum Gravity"

Summary: *"In this talk I will present some recent developments in QFT on curved spacetimes obtained within the framework of locally covariant quantum field theory (LCQFT). In particular, I will show how LCQFT helps to understand the concept of diffeomorphism invariant relational observables in classical gravity and how such objects can be quantized. This provides a new way of approaching quantum gravity, at least in the regime where the quantum effects are not too large".*

Rafael René del Rio Castillo

Universidad Nacional Autónoma de México

"Inverse Spectral Problems for Jacobi Operators"

Summary: *"We consider a linear finite spring mass system which is perturbed by modifying one mass and adding one spring. From knowledge of the natural frequencies of the original and the perturbed systems we study when masses and springs can be reconstructed. This is a problem about rank two or rank three type perturbations of finite Jacobi matrices where we are able to describe quite explicitly the associated Green's functions. We give necessary and sufficient conditions for two given sets of points to be eigenvalues of the original and modified system respectively. For semi infinite spring mass sytems, semi infinite Jacobi matrices are considered and similar results obtained". This is joint work with M. Kudryavtsev and L. Silva.*

Manfred Salmhofer

Universität Heidelberg

"Correlation Functions of Dilute Many-Fermion Models"

Summary: *"I will discuss a construction of the correlation functions of dilute many-fermion models in three spatial dimensions based on field theoretic multiscale methods. The diluteness condition implies that the basic power counting is that of a renormalizable theory. A novel aspect of this construction is that the scale decomposition does not involve the frequency variables, so that the analyticity structure can be preserved".*

Yoh Tanimoto

The University of Tokyo and Universität Göttingen

"Wedge-local fields in integrable QFT with bound states", (with D. Cadamuro).

Summary: *"Recently, large families of two-dimensional quantum field theories with factorizing S-matrices with analytic components have been constructed by the operator-algebraic methods, by first showing the existence of observables localized in wedge-shaped regions. We try to extend this program to S-matrices with poles in the physical strip: we construct candidates for observables in wedges and show that they weakly commute on a certain domain. We discuss some technical issues concerning further developments". Paper: http://arxiv.org/abs/1502.01313.*

Paulo Faria da Veiga

Universidade de São Paulo, ICMC, São Carlos

"The Particle Spectrum of Strongly Coupled Lattice QCD Models"

Summary: *"We will review the methods and results of a long-standing project aiming at obtaining the energy-momentum spectrum of lattice QCD, in the strong coupling regime, from first principles: that is, using quarks, gluons and their dynamics. Considering different values for the Euclidean spacetime and spin space dimension, and different number of flavors, our spectral results concentrate on the one-baryon and the one-meson spectrum and their two-particle bound states". This is a joint work with M. O'Carroll and other collaborators.*

Rainer Verch

Universität Leipzig

"Unruh Effect, Tolman Temperature and All That"

Summary: *"The Unruh effect asserts that a pointlike detector system which is coupled to a quantum field in the inertial vacuum state, and which is uniformly accelerated, will be found in a Gibbs-state in the the limit of large times and weak couplings, with the detector temperature proportional to the acceleration. We argue that the temperature indicated by the detector should not be taken as the the physical Tolman temperature of the vacuum state, as this leads to contradictions. Moreover we discuss if the Unruh detector measures the temperature of the vacuum state at all". The talk is based on joint work with Detlev Buchholz (arXiv:1412:5892).*

Walter Wreszinski

Universidade de São Paulo, IFUSP

"Equilibrium and Nonequilibrium Properties of Superfluids and Superconductors"

Summary: *"Equilibrium versus nonequilibrium properties for superfluids and superconductors. General aspects: the Sirugue-Winnink argument and semipassivity. Properties of green functions for infinite systems and definition of non equilibrium stationary states (NESS). Superfluids as NESS and their metastability. The Girardeau-Lieb-Liniger model. Open problems".*
