Fachverband Theoretische und Mathematische Grundlagen der Physik (MP)

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Übersicht der Hauptvorträge und Fachsitzungen

(Hörsäle KGI-HS 1098, KGI-HS 1099 und KGI-HS 1023)

Preisträgervortrag

PV IV	Mi	11:45–12:30	KGII-Audimax	**Fortschritte in der relativistischen Quantenfeldtheorie: Vom Verständnis der Grundlagen zu neuen Konstruktionsverfahren** — •Detlev Buchholz

Hauptvorträge

MP 1.1	Di	9:00– 9:45	KGI-HS 1098	**Geometrische Aspekte nichtkommutativer Feldtheorien** — •Stephan Waldmann
MP 1.2	Di	9:45–10:30	KGI-HS 1098	**Gross-Pitaevskii-Equation for the Dynamics of Bose-Einstein Condensates** — •Benjamin Schlein
MP 2.1	Do	9:45–10:30	KGI-HS 1098	**Can Entanglement be Distilled From Nothing? Quantum Fields and Infinite Spin Systems as Entanglement Resources** — •Michael Keyl
MP 3.1	Do	11:45–12:30	KGI-HS 1199	**Noncommutative Quantum Field Theory** — •Harald Grosse

Fachsitzungen

MP 1.1–1.2	Di	9:00–10:30	KGI-HS 1098	**Hauptvorträge**
MP 2.1–2.1	Do	9:45–10:30	KGI-HS 1098	**Hauptvortrag**
MP 3.1–3.1	Do	11:45–12:30	KGI-HS 1199	**Hauptvortrag**
MP 4.1–4.6	Di	14:00–16:00	KGI-HS 1023	**Quantentheorie und Quantisierung**
MP 5.1–5.3	Di	17:00–18:00	KGI-HS 1023	**Vielteilchentheorie**
MP 6.1–6.6	Mi	17:00–19:00	KGI-HS 1023	**Quantenfeldtheorie**
MP 7.1–7.6	Do	14:00–16:00	KGI-HS 1023	**Nichtkommutative Geometrie**
MP 8.1–8.3	Do	17:00–18:00	KGI-HS 1023	**Quanten-Informationstheorie**
MP 9.1–9.1	Do	18:30–18:50	KGI-HS 1023	**Alternative Ansätze**

Mitgliederversammlung des Fachverband Theoretische und Mathematische Grundlagen der Physik

Dienstag 18:20–19:00 Raum KGI-HS 1023

MP 1: Hauptvorträge

Zeit: Dienstag 9:00–10:30 Raum: KGI-HS 1098

Hauptvortrag MP 1.1 Di 9:00 KGI-HS 1098
Geometrische Aspekte nichtkommutativer Feldtheorien — •Stephan Waldmann — Physikalisches Institut, Fakultät für Mathematik und Physik, Universität Freiburg

In diesem Vortrag werde ich verschiedene geometrische Aspekte der nicht-kommutativen Feldtheorien auf nicht-kommutativen Raumzeiten vorstellen: zuerst soll das Konzept einer nicht-kommutativen Raumzeit einer kritischen Diskussion unterzogen werden, was zum Begriff einer lokal nicht-kommutativen Raumzeit führen wird. Als zweites betrachte ich die geometrische Formulierung von Materiefeldern mittels deformierter Vektorbündel. Hier wird insbesondere die Positivität der Massenterme von Interesse sein. Abschließend gebe ich einen Ausblick auf die Geometrie von Eichfeldtheorien. Dazu betrachtet man deformierte Hauptfaserbündel und die zugehörigen assoziierten Vektorbündel.

Hauptvortrag MP 1.2 Di 9:45 KGI-HS 1098
Gross-Pitaevskii-Equation for the Dynamics of Bose-Einstein Condensates — •Benjamin Schlein — Mathematisches Institut, LMU München

In this talk I am going to discuss recent results concerning the dynamics of Bose-Einstein condensates. In particular, I am going to present a mathematically rigorous derivation, starting from many body quantum dynamics, of the Gross-Piteavskii equation for the time evolution of the condensate wave function.

MP 2: Hauptvortrag

Zeit: Donnerstag 9:45–10:30 Raum: KGI-HS 1098

Hauptvortrag MP 2.1 Do 9:45 KGI-HS 1098
Can Entanglement be Distilled From Nothing? Quantum Fields and Infinite Spin Systems as Entanglement Resources — •Michael Keyl — Institute for Scientific Interchange, Torino

Entanglement is a crucial resource of quantum information theory which is necessary to outperform classical information processing by quantum devices. Therefore it is important to quantify entanglement and to find methods which can provide large amounts of it. This talk starts with a short review of entanglement theory focusing in particular on entanglement measures and on entanglement distillation (i.e. methods to extract maximally entangled particles from a big amount of low entangled systems). These concepts are then generalized to infinite degrees of freedom systems like quantum fields and infinite spin chains. In this context several interesting new phenomena occur, including in particular the possibility to have infinite entanglement. Therefore it is possible (at least in principle) to distill an infinite amount of maximally entanglement qubit pairs from the vacuum state of a quantum field, i.e. from effectively "nothing".

MP 3: Hauptvortrag

Zeit: Donnerstag 11:45–12:30 Raum: KGI-HS 1199

Hauptvortrag MP 3.1 Do 11:45 KGI-HS 1199
Noncommutative Quantum Field Theory — •Harald Grosse — Fakultät für Physik, Universität Wien

The unsolved problems of Quantum Field Theory led to the opinion that gravity should be included. This leads to the formulation of Quantum field Theories on Fuzzy Space-Time. We were able to obtain a few remarkable results for the renormalized pertubation expansion. The Landau ghost problem is solved. We suppose that a nonpertubative construction of a Higgsfield model will result, the renormalization trajectories are bounded which solves the triviality problem. Deformed Standard model and deformed Gravity are lively expanding subjects which will be reviewed too. There are some measurable implications.

MP 4: Quantentheorie und Quantisierung

Zeit: Dienstag 14:00–16:00 Raum: KGI-HS 1023

MP 4.1 Di 14:00 KGI-HS 1023
Deformationsquantisierung von Hauptfaserbündeln — •Stefan Weiss[1], Martin Bordemann[2], Nikolai Neumaier[1] und Stefan Waldmann[1] — [1]Albert-Ludwigs-Universität, Freiburg, Deutschland — [2]Université de Haute-Alsace, Mulhouse, Frankreich

Die Deformationsquantisierung ist ein algebraisch-geometrischer Zugang zu nichtkommutativen Raumzeiten. Für eine Untersuchung entsprechender Eichtheorien auf solchen Raumzeiten bietet die geometrische Formulierung mit Hilfe von Hauptfaserbündeln den angemessenen mathematischen Rahmen. In diesem Vortrag wird erklärt, was unter einer Deformationsquantisierung von Hauptfaserbündeln zu verstehen ist und wie in diesem Zusammenhang assoziierte Vektorbündel auftreten.

MP 4.2 Di 14:20 KGI-HS 1023
Wigner's theorem - revisited. A simple proof using projective geometry. — •Kai Johannes Keller[1,2], Nikolaos A. Papadopoulos[2], and Andrés Fernando Reyes Lega[3] — [1]II. Institut für Theoretische Physik der Universität Hamburg — [2]Institut für Physik der Universität Mainz (AG THEP) — [3]Universidad de los Andes, Bogotá, Colombia

This talk presents a a simple, geometric proof of Wigner's theorem on the realization of symmetries in quantum mechanics, that clarifies its relation to projective geometry.

Although there exist several proofs, it seems that the relevance of Wigner's theorem is not fully appreciated in general. It is Wigner's theorem, which allows the use of linear realizations of symmetries and therefore guarantees that, in the end, quantum theory stays a linear theory. The proof presented here takes a strictly geometrical point of view. It becomes apparent, that Wigner's theorem is nothing else but a corollary of the fundamental theorem of projective geometry. In this sense the proof is simple, transparent and therefore accessible even to elementary treatments in quantum mechanics.

MP 4.3 Di 14:40 KGI-HS 1023
Quantisierung integrabler Systeme mittels torischer Entartungen — •Michael Carl — Uni Freiburg

Die meisten kompaktifizierten integrablen 4-Systeme sind komplex algebraisch. Das liefert eine kanonische Quantisierung im Falle torischer Systeme, die wir auf solche mit Monodromie zu erweitern suchen, indem wir assoziierte torische Entartungen betrachten.

MP 4.4 Di 15:00 KGI-HS 1023
A modified Schwinger variation principle — •Mario Kieburg — University Duisburg-Essen, Theoretical Physics

The Schwinger variation principle published in the early 50'th is a quantum field variation principle which is commonly not used in quantum theory contrary to the canonical Dirac- or the Feynman-path-integral quantization. However, it has the advantage that the starting point of a description of a quantum system does not lie in the classical field theory but in a Lagrangian which already contains the field operators. Also, one obtains the operator field equations and the commutation relations after the variation. The well-known problem is that the results depend on the choosen foliation of the space-time. This is deeply connected with a distinction of a time. In the presentation we will modify the Schwinger variation principle using the method of bundle formulation to make the variation theory covariant under the change of hypersurfaces and, hence, foliations.

MP 4.5 Di 15:20 KGI-HS 1023

Fedosov Konstruktion für Kähler-Mannigfaltigkeiten mit konstanter holomorpher Schnittkrümmung — •Johannes Löffler — Physikalisches Institut, Freiburg

Die Konstruktion von Sternprodukten auf symplektischen Mannigfaltigkeiten nach Fedosov kann, da sie konstruktiv mit elementaren Differentialgeometrischen Mitteln die Existenz von Sternprodukten belegt, als fundamental für die Deformationsquantisierung angesehen werden. Ein weiteres Indiz für ihre große Bedeutung ist, dass sie auch eine Ausgangsposition für die Klassifizierung der Sternprodukte auf symplektischen Mannigfaltigkeiten bietet.

Die Assoziativität von Sternprodukten ist eine nichtlineare Bedingung. Die Schwierigkeit der Fedosov-Konstruktion resultiert in einer nichtlinearen Fixpunktgleichung die ein Differential, die Fedosov-Derivation, bestimmt.

Im von mir betrachteten Fall vereinfacht sich, wegen der kovarianten Konstanz der Krümmung, die Konstruktion der Fedosov-Derivation erheblich. Es lassen sich sogar alle Kähler-Mannigfaltigkeiten mit konstanter holomorpher Schnittkrümmung simultan behandeln und explizite Lösungen bestimmt werden.

MP 4.6 Di 15:40 KGI-HS 1023

Vollständige Positivität der Quantenzeitentwicklung dissipativer Subsysteme im Rahmen der Deformationsquantisierung — •Florian Becher, Nikolai Neumaier und Stefan Waldmann — Fakultät für Mathematik und Physik, Physikalisches Institut, Albert-Ludwigs-Universität Freiburg

Wir betrachten in diesem Vortrag vollständige Positivität der Quantenzeitentwicklung dissipativer Subsysteme im Rahmen der Deformationsquantisierung.

MP 5: Vielteilchentheorie

Zeit: Dienstag 17:00–18:00 Raum: KGI-HS 1023

MP 5.1 Di 17:00 KGI-HS 1023

Die Grundzustandsenergie großer Atome: Die Scottkorrektur — Rupert Frank[1], •Heinz Siedentop[2] und Simone Warzel[1] — [1]Department of Mathematics, Princeton University, Princeton, NJ 08544-1000, USA — [2]Mathematisches Institut, Ludwig-Maximilians-Universität München, Theresienstr. 39, 80333 München

Die Grundzustandsenergie $E(Z)$ großer neutraler Atome (große Ordnungszahl Z) wird asymptotisch durch die Thomas-Fermi-Energie $E_{\mathrm{TF}}(Z) = E_{\mathrm{TF}}(1)Z^{7/3}$ gegeben (Lieb und Simon 1977). Die führende Korrektur, die sogenannte Scottkorrektur ist $Z^2/2$ (Siedentop und Weikard 1987). Dieses Bild der Grundzustandsenergie ist im Rahmen der nichtrelativistischen Quantenmechanik korrekt. Nun erzwingt allerdings die zunehmende Kernladung eine so schnelle Bewegung der inneren Elektronen, daß die zu Grunde liegende nichtrelativistische Schrödingergleichung unter physikalischem Aspekt fragwürdig und eine relativistische Beschreibung notwendig wird. Wir zeigen, daß die Grundzustandsenergie des von Brown und Ravenhall (1951) aus der Quantenelektrodynamik hergeleiteten Hamiltonoperators eines Atoms sich wie

$$E_{\mathrm{BR}}(Z) = E_{\mathrm{TF}}(1)Z^{7/3} + f(Z/c)Z^2 + o(Z^2)$$

verhält, wobei $f(Z/c) < 1/2$ gilt. Während der führende Energiebeitrag also unverändert bleibt, wird die Scottkorrektur erniedrigt, was eine Vermutung von Schwinger (1980) bestätigt.

MP 5.2 Di 17:20 KGI-HS 1023

The zero-entropy-density conjecture — •Zoltán Zimborás[1] and Szilárd Farkas[2] — [1]Theoretische Physik, Universität des Saarlandes, Saarbrücken 66041 Campus 1, Germany — [2]Department of Physics, University of Chicago, Chicago, Illinois 60637

A natural and long-standing conjecture in mathematical quantum statistical physic is that the entropy density vanishes for all translation-invariant pure states on a quantum spin-chain. Or equivalently, S(N), the von Neumann entropy of such a state restricted to N consecutive spins, is sublinear. We report on a new result about this conjecture. We have shown that this conjecture cannot be sharpened, i.e., translation-invariant states give rise to arbitrary fast sublinear entropy growth. The proof is constructive, and is based on a class of states derived from quasifree states on a CAR algebra. We will also discuss the d-dimensional case, and a general lower-bound on the entropy asymptotics of pure shift-invariant quasifree states will be given.

References:
1) S. Farkas and Z. Zimborás, J. Math. Phys. 48, 102110 (2007).
2) S. Farkas and Z. Zimborás, J. Math. Phys. 46, 123301 (2005).

MP 5.3 Di 17:40 KGI-HS 1023

A statistical mechanical analogue of the second law: The increase of entropy upon release of a constraint in classical systems. — •Jürgen Schlitter — Lehrstuhl für Biophysik, Ruhr-Universität Bochum, Deutschland

Computer simulations have drawn new attention to holonomic constraints being used for simplified calculations, and also for maintaining and parameterizing equilibrium states. Second-law like phenomena of relaxation and equilibration are familiar to computational physicists. Their analysis has been facilitated by methods for calculating thermodynamic potentials which now enable a new approach to the formal foundation of the observed behavior. Here, we first consider classical mechanical systems which are fixed in a conditional equilibrium by means of constraints. If there are mean forces under this condition, they are shown to be purely entropic. Next, spontaneous transitions at constant energy are considered which occur upon release of a constraint. For any such transition it is shown that it leads on average to a region of higher entropy in phase space. This is a formally derived analogue of the second law of thermodynamics. Examples of constrained systems are given which show the range of application of this approach. The result is discussed with respect to a seeming contradiction to time symmetry. The latter manifests itself by the occurrence of residual fluctuations. It is not violated during the formal derivation, but by the underlying experimental setup. Entropy is only measured at equilibrium. The two-step mode of release and constraint is essential for the formal result. Reference: J. Schlitter, Mol. Phys. 104: 2829-2834, 2006

MP 6: Quantenfeldtheorie

Zeit: Mittwoch 17:00–19:00 Raum: KGI-HS 1023

MP 6.1 Mi 17:00 KGI-HS 1023

Wedge-Local Quantum Field Theory — •Gandalf Lechner[1], Detlev Buchholz[2], and Harald Grosse[3] — [1]Erwin-Schrödinger-Institut für Mathematische Physik, Wien, Österreich — [2]Universität Göttingen — [3]Universität Wien

In the construction of relativistic quantum field theories, field operators which are not point-localized, but rather localized in wedge-shaped regions of dimensional Minkowski space, are a novel tool.

In two dimensions, such fields have led to the solution of the inverse scattering problem for factorizing S-matrices, i.e. the construction of

integrable models with prescribed scattering operators. Recently, covariant families of wedge-local fields have also been established in higher dimensions. Although the connection between such objects and the S-matrix is less direct in higher dimensions, wedge-local quantum fields still provide a useful tool for the characterization of local observables and local interactions.

In this talk, a survey of the underlying ideas, results and perspectives of this approach is given.

MP 6.2 Mi 17:20 KGI-HS 1023

Phase space structure and the uniqueness of the vacuum in QFT — •Wojciech Dybalski — University of Göttingen, Germany

It is shown that only one vacuum state can be prepared with a finite amount of energy in any theory which satisfies a recently proposed phase space condition. This new criterion, which is verified in free field theory, restricts correlations between spatially separated regions. Conclusions about time-like asymptotic structure of physical states are derived.

MP 6.3 Mi 17:40 KGI-HS 1023

Conformal correlation functions in four dimensions: new insights — •Karl-Henning Rehren[1], Nikolay M. Nikolov[2], and Ivan Todorov[2] — [1]Institut für Theoretische Physik, Univ. Göttingen — [2]INRNE, Sofia, Bulgarien

It is well known that conformal correlation functions are essentially functions of the conformal cross ratios, with some constraints on their singularity structure. Otherwise, little is known about these functions. Assuming Huygens' principle, a much stronger restriction is established which can be cast into the form of a universal third order differential equation for the most singular terms. Nontrivial solutions can occur only at more than five point correlations. A nontrivial six-point solution is presented and discussed.

MP 6.4 Mi 18:00 KGI-HS 1023

Solutions of the semiclassical Einstein equations with possible interpretations in cosmology. — Claudio Dappiaggi, Klaus Fredenhagen, and •Nicola Pinamonti — II. Institut fuer Theoretische Physik, Universitaet Hamburg, Luruper Chaussee 149, D-22761 Hamburg, Germany

In addressing the problem of the definition of a semiclassical Einstein equation, the renormalization of the stress tensor plays a crucial role. We review in detail the case of a scalar field with general mass and general coupling with gravity, where the underlying quantum state is of Hadamard type. Using the ambiguity present in the point splitting procedure, Wald's axioms can be satisfied. We discuss the solutions of the semiclassical Einstein equation with high symmetry: in general they depend upon the quantum state. By means of the proposed method some solution of de Sitter type could arise even if we have not used any cosmological constant. Furthermore these solutions turn out to be stable. Even if the discussed model is very simple it shows that quantum effect are not negligible in addressing similar problems. We discuss some of the implications in cosmology.

MP 6.5 Mi 18:20 KGI-HS 1023

Quantum Energy Inequalities from Local Thermal Equilibrium — •Jan Schlemmer and Rainer Verch — Inst. f. Theoretische Physik, Universität Leipzig, 04009 Leipzig

This talk will be about the relation between a certain notion of local thermality for states of the free scalar field on curved spacetime backgrounds and quantum energy inequalites. For states fulfilling the condition of local thermality we will present two results obtained together with for arbitrary curvature coupling: First a Quantum Weak Energy Inequality and second an expression for potential violations of the Averaged Null Energy Inequality, which involves only terms with a direct physical interpretation for the states under consideration. Furthermore this expression shows that examples proposed to point out limits to Quantum Energy Inequalities for nonminimally coupled scalar fields are already the worst case for the set of locally thermal states.

MP 6.6 Mi 18:40 KGI-HS 1023

Field Theory in Goedel-type Spacetimes — •Piotr Marecki — Institut für Theoretische Physik, Universität Leipzig, 04009 Leipzig

I will discuss mathematical aspects of the massless scalar field in spacetimes of Goedel type. Due to their high symmetry, these spacetimes might provide an arena for the next step of development of concrete models of quantum fields in curved spacetimes, such as these developed already for the de Sitter spacetime. While the motion of the sources of Goedel spacetimes (dust with non-vanishing vorticity) is physically interesting and not too-implausible, a difficulty with causality is encountered: sufficiently large regions of Goedel spacetimes posses CTCs. A complete picture of the classical solutions of the wave equation, which will be presented, sheds some light on the seriousness of this difficulty from the point of view of classical field theory and provides a link to known treatments of quantum fields in simple non-globally hyperbolic spacetimes such as time-like cylinders etc. I shall present an algebraic construction of the solutions based on the symmetry-generators of Goedel-type spacetimes and a connection to the analysis of unitary irreducible representations of SU(1,1).

MP 7: Nichtkommutative Geometrie

Zeit: Donnerstag 14:00–16:00 Raum: KGI-HS 1023

MP 7.1 Do 14:00 KGI-HS 1023

Morita-Äquivalenz, Hopf-Algebren und Deformationsquantisierung — •Stefan Jansen, Stefan Waldmann und Nikolai Neumaier — Fakultät für Mathematik und Physik, Physikalisches Institut, Freiburg

In diesem Vortrag werde ich einige wesentlich Ergebnisse meiner Doktorarbeit vorstellen. In dieser habe ich mich mit der Morita-Äquivalenz von *-Algebren, d.h. Algebren mit einen antilinearen Antiautomorphismus auseinandergesetzt, die mit einer durch eine Hopf-*-Algebra induzierte Symmetrie ausgestattet sind. Ich werde die wesentlichen Konzepte und ergebnisse vorstellen, sowie die Bedeutung für die moderne Physik herauszuarbeiten.

MP 7.2 Do 14:20 KGI-HS 1023

Neutrino Masses in Noncommutative Geometry — •Christoph Alexander Stephan — Universität Potsdam, Institut für Mathematik, Am Neuen Palais 10, 14469 Potsdam

During the last two decades Alain Connes developed noncommutative Geometry, which allows to unify two of the basic theories of modern physics: General Relativity and the Standard Model of Particle Physics.

In its original version the noncommutative Standard Model allowed only Dirac-Neutrinos. Recently Alain Connes and John Barrett showed that this is due to the fact that the internal space of noncommutative Geometry is Euclidian in an algebraic sense. If one changes its signature from Euclidian to Minkowskian signature, Majorana mass terms are in principle allowed and the SeeSaw mechanism appears naturally.

In this talk I will give an overview of the different possibilities to introduce neutrino masses in the noncommutative Standard Model à la Connes. Since Majorana masses for right-handed Neutrinos result in an incompatibility with the Connes' axiom of orientability for noncommutative spaces, I will present a model which offers a bypass to the SeeSaw mechanism by enlarging the Standard Model particle content while respecting the whole set of axioms.

MP 7.3 Do 14:40 KGI-HS 1023

Recent Results on the Topology of Non-commutative Geometry on the Lattice — Wolfgang Frisch[1], Harald Grosse[2], •Harald Markum[1], and Florian Teischinger[1] — [1]Atominstitut, Vienna University of Technology, Austria — [2]Department for Theoretical Physics, University of Vienna, Austria

Theories with noncommutative space-time coordinates represent alternative candidates of grand unified theories. We discuss U(1) gauge theory in 2 dimensions on a lattice with N sites [1]. The mapping to a U(N) one-plaquette model in the sense of Eguchi and Kawai can be used for computer simulations. We are interested in the formulation and evaluation of topological objects [2]. We performed quantum Monte Carlo simulations and calculated the topological charge for different matrix sizes and several values of the coupling constant. We constructed classical gauge field configurations with large topological

charge and used them to initialize quantum simulations. It turned out that the value of the topological charge is decreasing during a Monte Carlo history. Our results show that the topological charge is in general supressed. The situation is similar to lattice QCD where quantum gauge field configurations are topologically trivial and one needs to apply some cooling procedure on the gauge fields to unhide the integer number of the instantons. Our recent analyses will be presented [3].

[1] W. Bietenholz et al., Fortsch. Phys. 53 (2005) 418
[2] H. Aoki, J. Nishimura, Y. Susaki, hep-th/0602078
[3] W. Frisch, H. Grosse, H. Markum, PoS(LAT2007)317

MP 7.4 Do 15:00 KGI-HS 1023

On positivity and normalization for a quantum field theory on non–commutative spacetime — •Christoph Dehne — ITP, Universität Leipzig, Vor dem Hospitaltore 1, D - 04103 Leipzig

It is well–known that for non–commutative theories with time/space non–commutativity different perturbation schemes (for vacuum expectation values of quantum fields) are no longer equivalent. Therefore, we would like to find out which ones respect the criteria necessary for a probability interpretation, namely positivity and normalization. To this end, we derive - under special assumptions - spectral representations and sum rules that correspond to the different perturbation schemes. Then, in each case, we make a perturbative analysis of the spectral density for a theory with ϕ^3_*–interaction. It turns out that the conditions are fulfilled by those Feynman rules that are considered as unitary. However, as for those Feynman rules that are "usually known to violate unitarity", we argue that they can be understood as positivity and normalization preserving distributions, too.

MP 7.5 Do 15:20 KGI-HS 1023

Dirac Field on Moyal-Minkowski Spacetime — •Markus Borris and Rainer Verch — Inst. f. Theoretische Physik, Universität Leipzig, 04009 Leipzig

We present the Dirac field on Moyal-Minkowski spacetime as a model of quantum field theory on a Lorentzian non-commutative background spacetime. This provides an example for a quantum field theory on Lorentzian spectral geometries proposed by M. Paschke and R. Verch, and others. The scattering of the Dirac field coupled to a non-commutative potential term is investigated and it is shown that the scattering transformation is unitarily implementable in the vacuum Hilbert-space representation of the Dirac field. The way in which the scattering transformations induce observables of the Dirac field on Moyal-Minkowski spacetime, and their possible interpretation, will also be discussed.

MP 7.6 Do 15:40 KGI-HS 1023

Zustände auf nichtkommutativen Raumzeiten — •Daniel Kaschek, Nikolai Neumaier und Stefan Waldmann — Physikalisches Institut, Freiburg

Im Bestreben, eine Quantentheorie der Gravitation zu entwickeln, sind neben vielen weiteren Kandidaten auch nichtkommutative Quantenfeldtheorien in den Blickpunkt gerückt. Die Nichtkommutativität bezieht sich dabei auf die Raumzeit selbst. Was jedoch genau unter einer nichtkommutativen Raumzeit zu verstehen ist, gilt es erst noch zu klären.

Ein mathematisches Modell zur Beschreibung einer Raumzeit mit nichtkommutativer Struktur basiert auf Techniken der Deformationsquantisierung. Mit Hilfe der Rieffel-Konstruktion wird die Funktionenalgebra der Observablen auf der Raumzeit zu einer nichtkommutativen C*-Algebra deformiert. Zustände und Erwartungswerte sind somit formal erklärt.

Der konkrete Zugang zu den Zuständen eröffnet sich jedoch erst, nachdem man den aus der formalen Deformationsquantisierung bekannten Übergang zwischen Weyl- und Wickprodukt auf den konvergenten Rahmen überträgt und die benötigten Positivitätseigenschaften so direkt sichtbar werden.

MP 8: Quanten-Informationstheorie

Zeit: Donnerstag 17:00–18:00 Raum: KGI-HS 1023

MP 8.1 Do 17:00 KGI-HS 1023

A not-so-normal mode decomposition — •Michael Wolf — Max-Planck-Institut für Quantenoptik, Hans-Kopfermann-Str.1, 85748 Garching

We provide a generalization of the normal mode decomposition for non-symmetric or locality constrained situations. This allows for instance to locally decouple a bipartitioned collection of arbitrarily correlated oscillators up to elementary pairs into which all correlations are condensed. Similarly, it enables us to decouple the interaction parts of multi-mode channels into single-mode and pair-interactions where the latter are shown to be a clear signature of squeezing between system and environment. In mathematical terms the result is a canonical matrix form with respect to real symplectic equivalence transformations. Applications in quantum information theory are outlined.

MP 8.2 Do 17:20 KGI-HS 1023

Haag duality of infinite quantum spin chains — •Michael Keyl[1], Taku Matsui[2], Dirk Schlingemann[1], and Reinhard F. Werner[3] — [1]ISI Foundation, 10133 Torino, Italy — [2]Graduate School of Mathematics, Kyushu Univ, 1-10-6 Hakozaki, Fukuoka 812-8581, Japan — [3]Institut für Mathematische Physik, TU Braunschweig, 38106 Braunschweig, Germany

In this talk we consider an infinite spin chain as a bipartite system consisting of the left and right half-chain and analyze Haag duality with respect to this splitting. Using Cuntz algebra methods we will show in particular that each pure, translational invariant state satisfies Haag duality. In addition the importance of this condition for entanglement theory of quantum spin systems is discussed.

[1] M. Keyl, T. Matsui, D. Schlingemann, R. F. Werner, Entanglement, Haag-duality and type properties of infinite quantum spin chains, Rev. Math. Phys. 18, no. 9, 935-970 (2006)

[2] M. Keyl, T. Matsui, D. Schlingemann, R. F. Werner, On Haag duality for pure states of quantum spin chains, math-ph/0703013

MP 8.3 Do 17:40 KGI-HS 1023

A Continuity Theorem for Stinespring's Dilation — Dennis Kretschmann[2,3], •Dirk-Michael Schlingemann[1,3], and Reinhard F. Werner[3] — [1]ISI Foundation Torino, Quantum information theory unit, Italy — [2]Quantum Information Theory Group, Dipartimento di Fisica A. Volta, Universita di Pavia, Italy — [3]Institut f. Mathematische Physik, TU-Braunschweig, Germany

We report on our article [arXive:0710.2495] in which we show a continuity theorem for Stinespring's dilation: two completely positive maps between arbitrary C*-algebras are close in cb-norm iff we can find corresponding dilations that are close in operator norm. The proof establishes the equivalence of the cb-norm distance and the Bures distance for completely positive maps. We also discuss applications to topics in quantum information theory, e.g., information-disturbance tradeoff and quantum bit commitment.

MP 9: Alternative Ansätze

Zeit: Donnerstag 18:30–18:50 Raum: KGI-HS 1023

MP 9.1 Do 18:30 KGI-HS 1023

Kraftlinienverlauf rotierter Massen — •Peter Kümmel — Amselweg 15 c; 21256 Handeloh

Vom Schwerpunkt einer Masse ausgehend, verlassen die Kraftlinien eine homogene Kugelmasse radial und treten von der Oberfläche senkrecht aus. Bei Rotation um den Massenschwerpunkt findet ab diesem eine Ablenkung der Kraftlinien entgegengesetzt zur Massenoberflächenbewegungsrichtung statt. Wird dieser zweidimensionalen Kraftlinienkrümmung durch Präzession eine dreidimensionale aufgezwungen, entsteht ein Verkürzen des Krümmungsradius. Diese Verkrümmungsveränderung pflanzt sich rückwirkend bis zum Massenschwerpunkt fort und verursacht ein Anwachsen der Drehzahl.