Fachverband Theoretische und Mathematische Grundlagen der Physik (MP)

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Übersicht der Hauptvorträge und Fachsitzungen

(Hörsaal M010)

Plenarvorträge des Symposiums Komplexität

Das vollständige Programm dieses Symposiums ist unter SYKO aufgeführt.

SYKO 1.1	Mo	13:00–13:35	A140	**Chaoticity and Complexity** — •Andreas Knauf
SYKO 1.2	Mo	13:35–14:10	A140	**The LHC-Project: Complexity in High Energy Physics** — •Thomas Lohse
SYKO 1.3	Mo	14:10–14:45	A140	**Structure Formation in Astrophysics - From Cosmology to Planets** — •Wolfgang Hillebrandt
SYKO 1.4	Mo	15:05–15:40	A140	**The Scaling Laws of Human Travel: Tracking Dollars for New Approaches to Epidemic Modeling** — •Theo Geisel
SYKO 1.5	Mo	15:40–16:15	A140	**Challenges of Complexity in Natural, Technical and Economic Sciences** — •Klaus Mainzer

Plenarvorträge

PV I	Di	11:00–11:45	Audimax	**Kosmologie, Krümmung, und Quantenfelder** — •Stefan Hollands
PV II	Di	11:45–12:30	Audimax	**On the topology of the Universe.** — •Frank Steiner

Hauptvorträge

MP 2.1	Di	9:00– 9:45	M010	**Many-Body Effects in Mesoscopic Systems – a Functional Renormalization Group Approach** — •Volker Meden
MP 2.2	Di	9:45–10:30	M010	**An Information-Geometric Approach to Complexity Theory** — •Nihat Ay
MP 9.1	Do	10:15–11:00	M010	**Noncommutative Gravity** — •Peter Schupp
MP 10.1	Do	11:45–12:30	M010	**Aspects of Quantum Fields on Cosmological Models** — •Nicola Pinamonti

Fachsitzungen

MP 1.1–1.4	Mo	17:15–18:35	M010	**Quanten- Information, Komplexität**
MP 2.1–2.2	Di	9:00–10:30	M010	**Hauptvorträge**
MP 3.1–3.3	Di	14:00–15:00	M010	**Quantentheorie großer Systeme**
MP 4.1–4.3	Di	16:00–17:00	M010	**Quantentheorie und Quantisierung 1**
MP 5.1–5.4	Mi	9:00–10:20	M010	**Quantentheorie und Quantisierung 2**
MP 6.1–6.4	Mi	16:20–17:40	M010	**Felder und Strings**
MP 7.1–7.4	Mi	18:00–19:20	M010	**Quantentheorie und Quantisierung 3**
MP 8.1–8.3	Do	9:00–10:00	M010	**Quantenfeldtheorie 1**
MP 9.1–9.1	Do	10:15–11:00	M010	**Hauptvortrag**
MP 10.1–10.1	Do	11:45–12:30	M010	**Hauptvortrag**
MP 11.1–11.4	Do	14:00–15:20	M010	**Nichtkommutative Geometrie**

MP 12.1–12.3	Do	16:00–17:00	M010	**Quantenfeldtheorie und Kosmologie**
MP 13.1–13.3	Do	17:30–18:30	M010	**Quantenfeldtheorie 2**
MP 14.1–14.3	Do	18:50–19:50	M010	**Alternative Ansätze**

Mitgliederversammlung Fachverband Theoretische und Mathematische Grundlagen der Physik

Dienstag 17:30–18:45 Raum M010

- Bericht
- Wahl
- Verschiedenes

MP 1: Quanten- Information, Komplexität

Zeit: Montag 17:15–18:35 Raum: M010

MP 1.1 Mo 17:15 M010

Tensor norms of operator systems and Tsirelson's problem — •Volkher Scholz and Reinhard F. Werner — Technical University of Braunschweig

We discuss some possible ambiguities in the definition of "correlations produced by quantum systems", which were noted by Acin [M. Navascues, S. Pironio and A. Acin, *Bounding the set of quantum correlations*, Phys. Rev. Lett 98, 010401 (2007)] and formulated in a sharp way by Tsirelson [B.S. Tsirelson, *Bell inequalities and operator algebras*, Problem 33 on the Braunschweig list, http://www.imaph.tu-bs.de/qi/problems/33.html]. The issue is the notion of "subsystem", or the kind of independence postulated between two observers Alice and Bob. If we just assume that all of Alice's observables commute with all of Bob's, we might get some larger set of correlations than if we assume in addition that these commuting observables act on different tensor factors in a tensor product decomposition of the underlying Hilbert space.

Tsirelson showed already that if the ambient Hilbert space is finite dimensional, this distinction is irrelevant. The problem of Tsirelson is to decide the question in case of arbitrary Hilbert spaces and observable algebras. We show here that the problem is equivalent to the question whether all quantum correlations can be approximated by correlations between finite dimensional systems. Although we do not offer a solution, we do link the problem to issues well-known in the theory of C*-algebras, von Neumann algebras and operator systems.

MP 1.2 Mo 17:35 M010

The algebra of Grassmann canonical anti-commutation relations and its application to fermionic systems — •Dirk-Michael Schlingemann, Michael Keyl, and Lorenzo Campos Venuti — ISI Foundation Torino, Quantum information group

The basic constituents of the matter that surrounds us in daily life are fermions. Therefore it is needless to say that theoretical investigation of fermion systems play an essential role in almost all areas of quantum physics. A particular class of states of fermion systems are quasi-free states. On one hand, this class of states can be treated analytically even for very large systems, on the other hand, these states are complex enough to describe ground states of interacting spin chain systems.

We present an approach to non-commutative phase space which allows to analyze quasi-free states on the CAR algebra in analogy to quasi-free states on the CCR algebra. The used mathematical tools are based on the Grassmann algebra of canonical anti-commutation relations (GAR algebra) which is given by the twisted tensor product of a Grassmann and a CAR algebra.

As a new application, the corresponding theory provides an elegant tool for calculating the fidelity of two quasi-free fermionic states which is needed for the study of entanglement distillation within fermionic systems.

MP 1.3 Mo 17:55 M010

Invariant states of Clifford Quantum Cellular Automata — •Zoltán Zimborás[1], Johannes Gütschow[2], Sonja Uphoff[2], and Reinhard Werner[2] — [1]Institut für Theoretische Physik, Universität des Saarlandes, Campus 1, 66041 Saarbrücken, Germany — [2]Institut für Mathematische Physik, Technische Universität Braunschweig, Mendelssohnstrasse 3, 38106 Braunschweig, Germany

Clifford Quantum Cellular Automata (CQCA) are a special kind of Quantum Cellular Automata for which the so-called Clifford condition ("products of Pauli matrices are mapped to products of Pauli matrices") is satisfied. In this talk we show how one can construct different (product, stabilizer, finitely correlated, quasifree) states that are invariant with respect to a given CQCA action. The possible convergence of non-invariant states to invariant ones under a CQCA action is also discussed. The similarities and differences between CQCA time-evolutions and time-evolutions generated by Hamiltonians (and the differences in the structure of invariant states) are shown by examples. Finally, applications in quantum information theory are outlined.

MP 1.4 Mo 18:15 M010

Outliers of exponentiated power-law variates could determine entire subjective histories — •Lutz Polley — Institut für Physik, Universität Oldenburg, 26111 Oldenburg

In the many-worlds view of an observer's physical evolution, I argue that the dimension of a cognitive Hilbert space, at the ends of decoherent branches, should be distributed like a power-law variate exponentiated. Order statistics of extreme and next-to-extreme values then implies that most of the dimension is located in a single branch.

MP 2: Hauptvorträge

Zeit: Dienstag 9:00–10:30 Raum: M010

Hauptvortrag MP 2.1 Di 9:00 M010

Many-Body Effects in Mesoscopic Systems – a Functional Renormalization Group Approach — •Volker Meden — Inst. f. Theoretische Physik, RWTH Aachen

Solid-state based artificial mesosocopic structures provide a well-controllable environment to study and manipulate quantum many-body effects. In a typical experiment the mesoscopic system is connected to two leads and the electron transport through the device is investigated (e.g. the linear and non-linear conductance is measured). For a theoretical understanding of transport properties it is quite often necessary to go beyond a standard mean-field treatment of the two-particle interactions. We describe an approximative approach to capture correlations which is based on the field theoretical functional renormalization group method. In this scheme a set of coupled differential equations for the one-particle irreducible m-particle vertex functions is derived. From the solution of these equations physical observables can be computed. We apply our method to several systems (such as quantum dots) and compare the results obtained on different levels of approximation to those derived by other methods as well as to the outcome of recent experiments. Based on this the merits and shortcomings of our approach are discussed.

Hauptvortrag MP 2.2 Di 9:45 M010

An Information-Geometric Approach to Complexity Theory — •Nihat Ay — MPI f. Mathematik i.d. Naturwissenschaften, Leipzig

In the first part of the talk, the information-geometric formalism will be introduced. Furthermore, based on the concept that the complexity of a system should reflect the extent to which that system, considered as a whole, cannot be characterized in terms of the properties of its parts, it will be demonstrated how information geometry provides a natural way to quantify complexity. In the second part of the talk, several results on complexity maximization will be presented. Finally, some open problems will be discussed.

MP 3: Quantentheorie großer Systeme

Zeit: Dienstag 14:00–15:00 Raum: M010

MP 3.1 Di 14:00 M010

Viewing Markovian Quantum Channels as Lie Semigroups and GKS-Lindblad Generators as Lie Wedge: New Perspectives and Applications — •Thomas Schulte-Herbrüggen[1], Gunther Dirr[2], Indra Kurniawan[2], and Uwe Helmke[2] — [1]Technical University Munich (TUM), Dept. Chemistry — [2]University of Würzburg, Institute of Mathematics

Optimal control of Markovian and non-Markovian open quantum systems cuts errors typically by one order of magnitude [1] in realistic settings. Yet open systems require more intricate theoretical concepts of controllability than their closed counterparts [2,3]. We present such new concepts in terms of Lie semigroups and Lie semialgebras [3].

On a general scale, Markovian quantum channels (with det>0) recently characterised by their divisibility [4] can now be defined in the more general frame of invariant cones by their Lie-semigroup properties [3] with the GKS-Lindblad generators as Lie wedge. Its geometry proves powerful for addressing reachability as well as for numerical algorithms both in optimal control and in optimisation on various types of reachable sets within quantum state-space manifolds [2,3].

[1] Schulte-Herbrüggen, Spörl, Khaneja, Glaser, quant-ph/0609037; Rebentrost, Serban, Schulte-H., Wilhelm, quant-ph/0612165
[2] Schulte-Herbrüggen, Dirr, Helmke, Glaser, arXiv:0802.4195
[3] Dirr, Helmke, Kurniawan, Schulte-Herbrüggen, arXiv:0811.3906
[4] Wolf and Cirac, Commun. Math. Phys. 279, 147 (2008); Wolf, Eisert, Cubitt, Cirac, PRL 101, 150402 (2008)

MP 3.2 Di 14:20 M010

Structural response properties of interacting quantum fields — •Lev Plimak[1] and Stig Stenholm[1,2,3] — [1]Abteilung Quantenphysik, Uni Ulm, D-89069 Ulm, Germany. — [2]Physics Department, Royal Institute of Technology, KTH, Stockholm, Sweden — [3]Laboratory of Computational Engineering, HUT, Espoo, Finland

We analyse nonperturbatively signal transmission patterns in Green's functions of interacting quantum fields, bosonic as well as fermionic. Quantum field theory is re-formulated in terms of the nonlinear quantum-statistical response of the field. This formulation applies equally to interacting relativistic fields and nonrelativistic models. Of crucial importance is that all causality properties to be expected of a response formulation indeed hold. Being by construction equivalent to Schwinger's closed-time-loop formalism, this formulation is also shown to be related naturally to both Kubo's linear response and Glauber's macroscopic photodetection theories, being a unification of the two with generalisation to the nonlinear quantum-statistical response problem.

MP 3.3 Di 14:40 M010

Instantons in Noncommutative U(1) Gauge Theory in Even Dimensions on the Lattice — Arifa Ali Khan[1] and •Harald Markum[2] — [1]Institute of Theoretical Physics, University of Regensburg — [2]Atominstitut, Vienna University of Technology

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. The mapping to a U(N) one-plaquette model in the sense of Eguchi and Kawai can be used for computer simulations. 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. At present we are working out the definition of instantons and monopoles in 4 dimensions. Concerning the topological charge it seems straightforward. and one can transcribe the plaquette and hypercube formulation to the matrix theory. The monopole observable seems to be more difficult. The analogy to commutative U(1) theory of summing up the phases of an elementary cube might need a projection on the abelian part of the U(N) theory in the matrix model.

MP 4: Quantentheorie und Quantisierung 1

Zeit: Dienstag 16:00–17:00 Raum: M010

MP 4.1 Di 16:00 M010

Berry Keating Operator on Graphs — •Sebastian Endres und Frank Steiner — Institut für Theoretische Physik Ulm, Albert Einstein Alle 11, 89081 Ulm

Berry und Keating untersuchten semiklassisch den Operator zur Hamilton-Funktion H=xp, da sie einen Zusammenhang vermuteten zwischen den Nullstellen der Riemann-Zeta Funktion und den Eigenwerten dieses Operators.

Sie schlugen vor, die Weylquantisierung von xp auf Graphen zu untersuchen. Im Vortrag soll

-der Berry-Keating Operator auf Graphen vorgestellt werden,

-eine Säkular Gleichung, eine Spurformel und das Weyl'sche Gesetzt für alle selbstadjungierten Realisierungen dieses Operators präsentiert werden,

-der Zusammenhang zum "normalen" Impulsoperator bzw. negativen Laplace-Operator (Quanten-Graphen) dargelegt werden.

MP 4.2 Di 16:20 M010

Der Zusammenhang zwischen mathematischer und physikalischer Verschränktheit — •Thomas Krüger — Institut für Chemie, Karl-Franzens-Universität Graz, Heinrichstraße 28, 8010 Graz, Österreich

Within the framework of a statistical interpretation of quantum mechanics entanglement (in a mathematical sense) manifests itself in the non-separability of the statistical operator ρ representing the ensemble in question. In experiments, on the other hand, entanglement can be detected, in the form of non-locality, by the violation of Bell's inequality $\Delta \leq 2$. How do these different viewpoints match? We employ a corrected von Neumann entropy to measure the (mathematical) degree of entanglement and show that, at least in the case of 2×2 dimensions, this function is directly related to Bell's correlation function Δ. This relation can be well approximated by an ellipse equation which, for the first time, allows for a direct comparison of the two faces of entanglement.

MP 4.3 Di 16:40 M010

Schwinger's variational principle in a modified form — •Mario Kieburg — Universität Duisburg-Essen, Lotharstraße 1, 47048 Duisburg

Schwinger's variational principle is a quantum field variational principle. Contrary to the canonical Dirac-quantization or Feynman's path-integral quantization, the starting point of describing a quantum system does not lie in a classical field theory. One gets both, the field equations and the commutation relations, by varying the expectation value of the action which is an operator on a Hilbert space.

Almost all quantum theories depend on the choice of the space-time foliation which is deeply connected with the distinction of a time. The original Schwinger variational principle is also of this type. We will present a modification of Schwinger's variational principle using the bundle formalism to make this principle covariant under the change of hypersurfaces in the space-time.

MP 5: Quantentheorie und Quantisierung 2

Zeit: Mittwoch 9:00–10:20 Raum: M010

MP 5.1 Mi 9:00 M010

Quantisierung linearer Poisson-Strukturen und spezielle Darstellungen — •Alexander Held, Nikolai Neumaier und Stefan Waldmann — Fakultät für Mathematik und Physik, Albert-Ludwigs-Universität Freiburg

Trägt ein Vektorbündel $E \to M$ über einer glatten Mannigfaltigkeit M die Struktur eines Lie-Algebroids, so ist dies äquivalent zur Existenz einer linearen Poisson-Struktur auf dem dualen Bündel $E^* \to M$ in dem Sinne, dass die Poisson-Klammer zweier in den Fasern polynomialer Funktionen vom Grad k und l eine in den Fasern polynomiale Funktion vom Grad $k + l - 1$ ergibt.

Mittels einer modifizierten Fedosov-Konstruktion lassen sich differentielle Sternprodukte für polynomiale Funktionen auf E^* angeben [1]. Für spezielle Sternprodukte dieses Typs werden Darstellungen betrachtet, für die sich lokal mit Hilfe von Differentialoperatoren explizite Formeln angeben lassen. Zudem lässt sich die Fedosov-Konstruktion auf Schnitte mit Werten in einem Vektorbündel über E^* ausdehnen.

[1] Neumaier, N., Waldmann, S.: Deformation Quantization of Poisson Structures Associated to Lie Algebroids. Preprint arXiv:0708.0516v2 [math.QA]

MP 5.2 Mi 9:20 M010

Positive stetige Felder von C^*-Algebren — •Stefan Waldmann, Daniel Kaschek und Nikolai Neumaier — Fakultät für Mathematik und Physik, Physikalisches Institut, Albert-Ludwigs-Universität Freiburg

In diesem Vortrag werde ich über ein gemeinsames Projekt mit Daniel Kaschek und Nikolai Neumaier berichten: Es wird gezeigt, dass das von Rieffel angegebene stetige Feld von C^*-Algebren, welches durch eine stark-stetige Wirkung von $\mathbb{R}^{2n}$ auf einer C^*-Algebra $\mathcal{A}$ konstruiert wird, eine positive Deformation ist: jedes positive Funktional der Algebra $\mathcal{A}$ läßt sich auf stetige Weise in ein positives Funktional des Feldes deformieren. Eine Interpretation im Rahmen der Deformationsquantisierung ist, dass jeder klassische Zustand klassischer Limes eines Quantenzustands ist.

MP 5.3 Mi 9:40 M010

Eine konvergente Algebra für das Wick-Sternprodukt auf der Poincaré Disc — •Svea Beiser und Stefan Waldmann — Fakultät für Mathematik und Physik, Physikalisches Institut, Hermann Herder Straße 3, 79104 Freiburg

Eine konvergente Algebra für das Wick-Sternprodukt wird auf der Poincaré Disc anhand einer Fréchet-Algebra gefunden. Die Poincaré Disc D^n ist eine Kähler-Mannigfaltigkeit mit der von dem komplexprojektiven Raum $\mathbb{C}P^n$ induzierten komplexen Struktur und negativer Krümmung. Die Vorgehensweise ist analog zu dem flachen Fall, der in *S.B., H.Römer, S.Waldmann: Convergence of the Wick Star Product. Commun. Math.Phys. 272(2007),25-52* dargestellt wurde.

MP 5.4 Mi 10:00 M010

Knots, particles and the geometry of 3-manifolds — •Torsten Asselmeyer-Maluga[1] and Helge Rosé[2] — [1]Aerospace Center (DLR), Rutherfordstr. 2, 12489 Berlin — [2]FhG FIRST, Kekulestr.7, 12489 Berlin

The model of Bilson-Thompson (hep-th/0603022) and its extension (arXiv:0804.0037) was the starting point in using again knots and links as a model for particles. It has some attractive features but many questions are open. We study an essential modification of the model which uses knot complements. Then we will get a connection between the particular knot and the geometry of the 3-manifold. This implies a relation between knot invariants and physical properties of a particle. The quantization using topology will be also discussed.

MP 6: Felder und Strings

Zeit: Mittwoch 16:20–17:40 Raum: M010

MP 6.1 Mi 16:20 M010

Local retarded off-shell intertwiners of covariant phase spaces - towards a nonperturbative construction — Romeo Brunetti[1], Klaus Fredenhagen[2], and •Pedro Lauridsen Ribeiro[2] — [1]Dipartimento di Matematica, Facoltà di Scienze Matematiche, Fisiche e Naturali, Università degli Studi di Trento, Italien — [2]II. Institut für theoretische Physik der Universität Hamburg

We describe the current status of a nonperturbative and mathematically rigorous construction of nonlinear operators acting on (a neighbourhood of the origin of) the space of smooth sections of a vector bundle over a general spacetime, which intertwine a pair of (left-hand sides of) strictly hyperbolic, second-order Euler-Lagrange field equations which differ by a compactly supported interaction term, and act as the identity in the remote past, thus playing the role of the retarded Møller operators from scattering theory. These operators were introduced by Dütsch and the second author in the context of perturbative algebraic quantum field theory. This construction is off-shell and makes use of a Nash-Moser iteration scheme.

MP 6.2 Mi 16:40 M010

Differential cohomology and gauge theories — •Alessandro Valentino — Mathematisches Institut, Georg-August-Universitaet Goettingen Bunsenstr. 3-5 D-37073, Goettingen, Germany

I will give an introduction to the applications of (generalized) differential cohomology to the gauge theory of p-form fields relevant to supergravity and string theory.

MP 6.3 Mi 17:00 M010

Cartesian integration of Grassmann variables over invariant functions — •Mario Kieburg, Heiner Kohler, and Thomas Guhr — Universität Duisburg-Essen, Lotharstraße 1, 47048 Duisburg

Supersymmetry plays an important role in field theory as well as in random matrix theory and mesoscopic physics. Anticommuting variables are the fundamental objects of supersymmetry. The integration over these variables is equivalent to the derivative. Recently [arxiv:0809.2674v1[math-ph] (2008)], we constructed a differential operator which only acts on the ordinary part of the superspace consisting of ordinary and anticommuting variables. This operator is equivalent to the integration over all anticommuting variables of an invariant function. We will present this operator and its applications for functions which are rotation invariant under the supergroups $\mathrm{U}(k_1/k_2)$ and $\mathrm{UOSp}(k_1/k_2)$.

MP 6.4 Mi 17:20 M010

'Weight' in the landscape from Quark and Lepton Masses — •Koushik Dutta — Max Planck Institute for Physics, Fohringer Ring 6, 80805, Munich, Germnay

Even if quark and lepton masses are not uniquely predicted by the fundamental theory, as may be the case in the string theory landscape, nevertheless their pattern may reveal features of the underlying theory. We use statistical techniques to show that the observed masses appear to be representative of a scale invariant distribution, rho(m) ~ 1/m. If we extend this distribution to include all the Yukawa couplings, we show that the resulting CKM matrix elements typically show a hierarchical pattern similar to observations. The Jarlskog invariant measuring the amount of CP violation is also well reproduced in magnitude. We also apply this framework to neutrinos using the seesaw mechanism. Our framework highly favors a normal hierarchy of neutrino masses and predicts several presently unmeasured observables.

In addition, using the scale invariant weight for the Yukawa couplings and imposing anthropic constraints on the existence of atoms, we estimate the likelihood function for the Higgs vev. The result favors values close to the observed vev.

MP 7: Quantentheorie und Quantisierung 3

Zeit: Mittwoch 18:00–19:20 Raum: M010

MP 7.1 Mi 18:00 M010

Quadratische Poisson-Strukturen auf Vektorbündeln — •Klaus Zimmermann, Nikolai Neumaier und Stefan Waldmann — Universität Freiburg, Freiburg, Baden-Württemberg

Lineare und quadratische Poisson-Strukturen sind die beiden wichtigsten Vertreter dieser Gattung. Sie tragen sowohl reiche geometrische als auch algebraische Struktur. Weiter gibt es zahlreiche Beispiele in der Physik.

Im Vektorraumfall sind die linearen Poisson-Strukturen in einszu-eins-Korrespondenz zu den Lie-Algebren. In den quadratischen Poisson-Strukturen wird eine wichtige Unterklasse durch Lösungen der Yang-Baxter-Gleichung, die sogenannten r-Matrizen klassifiziert.

Wir betrachten Poisson-Strukturen auf Vektorbündlen. Die linearen versteht man analog zum Vektorraumfall als Lie-Algebroide. Die quadratischen werden in diesem Vortrag definiert. Darüberhinaus werden einige Spezialfälle, insbesondere der symplektische und der triviale, diskutiert.

MP 7.2 Mi 18:20 M010

Invariante Sternprodukte und Morita-Theorie — Stefan Jansen, Nikolai Neumaier, •Gregor Schaumann und Stefan Waldmann — Albert-Ludwigs-Universität Freiburg, Deutschland

Ausgehend von der Existenz und Klassifikation von invarianten Sternprodukten diskutiere ich die Liftung von klassischen Symmetrien in der Deformationsquantisierung. Ein wichtiges Beispiel ist der flache Raum mit dem Weyl-Moyal-Sternprodukt. Auf allgemeineren Phasenräumen hilft die invariante Morita-Theorie sich dem Problem der Quantisierung von klassischen Symmetrien anzunähern.

MP 7.3 Mi 18:40 M010

Darstellung auf Prä-Hilbert-Moduln von positiven Quantenzeitentwicklungen offener Subsysteme im Rahmen der Deformationsquantisierung — •Florian Becher, Nikolai Neumaier und Stefan Waldmann — Fakultät für Mathematik und Physik, Physikalisches Institut, Hermann-Herder-Straße 3, 79104 Freiburg

Nach dem Nachweis der systematischen Konstruierbarkeit positiver Quantenzeitentwicklungen offener Subsysteme im letzten Jahr betrachte ich in diesem Jahr Darstellungen vollständig positiver Quantenzeitentwicklungen offener Subsysteme im Rahmen der Deformationsquantisierung. Die Darstellungsräume sind in diesem Fall Prä-Hilbert-Moduln über dem Ring der formalen Potenzreihen mit Koeffizienten in den komplexen Zahlen.

MP 7.4 Mi 19:00 M010

Invarianzen von Sternprodukten auf dem Dualen eines Lie-Algebroids — •Sönke Wienholdt, Nikolai Neumaier und Stefan Waldmann — Albert-Ludwigs-Universität Freiburg

Ein Lie-Algebroid ist eine Verallgemeinerung des Kotangentenbündels, auf dessen Dualem eine Poisson-Struktur existiert, welche im Allgemeinem nicht symplektisch ist. Neumaier und Waldmann haben gezeigt, wie man in diesem Fall durch eine verallgemeinerte Fedosov-Konstruktion Sternprodukte konstruieren kann. In meinem Vortrag werde ich erklären, was man in diesem verallgemeinerten Phasenraum unter Symmetrien versteht und Obstruktionen angeben, wann eine klassische Impulsabbildung beziehungsweise eine Quantenimpulsabbildung existiert, welche für eine Phasenraumreduktion nötig ist.

MP 8: Quantenfeldtheorie 1

Zeit: Donnerstag 9:00–10:00 Raum: M010

MP 8.1 Do 9:00 M010

Flow equations for supersymmetric field theories — •Franziska Synatschke — Theoretisch-Physikalisches Institut, Universität Jena, Deutschland

A manifestly supersymmetric exact renormalization group flow will be presented for the N=1 Wess-Zumino-Model in two dimensions.

For that prupose, supersymmetric regulators are constructed in the off-shell formulation. The considered model allows for dynamical supersymmetry breaking. The phase diagramm will be discussed as well as the fixed-point structure of the ERG-flow.

MP 8.2 Do 9:20 M010

All tree-level amplitudes in N=4 SYM — •Johannes Henn[1] and James Drummond[2] — [1]HU Berlin, Deutschland — [2]LAPTH, Annecy, Frankreich

We give an explicit formula for all tree amplitudes in N=4 SYM, derived by solving the recently presented supersymmetric tree-level recursion relations. The result is given in a compact, manifestly supersymmetric form and we show how to extract from it all possible component amplitudes for an arbitrary number of external particles and any arrangement of external particles and helicities. We focus particularly on extracting gluon amplitudes which are valid for any gauge theory. The formula for all tree-level amplitudes is given in terms of nested sums of dual superconformal invariants and it therefore manifestly respects both conventional and dual superconformal symmetry.

MP 8.3 Do 9:40 M010

Über eine Beziehung zwischen chiraler Symmetriebrechung und Confinement — •Andreas Wipf[1], Franziska Synatschke[1], Christian Wozar[1] und Kurt Langfeld[2] — [1]Friedrich-Schiller-Universität Jena — [2]University of Plymouth

Kürzlich ist es Forschergruppen in Graz, Regensburg und Jena gelungen eine exakte Beziehung zwischen zentrums-gemittelten spektralen Summen des Diracoperators und dem statischen Quark-Antiquark Potential sowie dem chiralen Kondensat zu beweisen. Nach den wichtigsten analytischen Resultaten über den neuen Zusammenhang zwischen Erwartungswerten von Polyakov-Schleifen und dem Quark-Kondensat werden auch Ergebnisse von numerischen Simulationen besprochen.

MP 9: Hauptvortrag

Zeit: Donnerstag 10:15–11:00 Raum: M010

Hauptvortrag MP 9.1 Do 10:15 M010

Noncommutative Gravity — •Peter Schupp — School of Engineering and Science, Jacobs University, Bremen

At length scales where both gravitational and quantum effects are important, the classical picture of smooth commutative spacetime should be replaced by some kind of quantum geometry. Such a noncommutative structure is however in general incompatible with local spacetime symmetries. We discuss how this problem can be overcome with an appropriately deformed tensor calculus in an approach based on star products and Drinfel'd twists. This leads to a formulation of general relativity on noncommutative spacetime. We explore solutions of the resulting deformed Einstein equations, and find in particular a fuzzy Schwarzschild-type geometry that quite naturally exhibits holographic behavior.

MP 10: Hauptvortrag

Zeit: Donnerstag 11:45–12:30 Raum: M010

Hauptvortrag MP 10.1 Do 11:45 M010
Aspects of Quantum Fields on Cosmological Models — •Nicola Pinamonti — II. Institut für Theoretische Physik, Universität Hamburg

In this talk we shall consider the backreaction of certain quantum fields on gravity. This will be done employing a very simple model for matter, namely the free quantum field, and using the Einstein equations in a semiclassical fashion. A central role in the discussion will be played by the analysis of the trace anomaly of the stress tensor in states with a good ultraviolet behavior. Even if the presented models are very simple, they show that the effect of renormalization could play an important role at cosmological level. The results presented in the first part of the talk rely on the existence of states on curved spacetime with nice ultraviolet behavior, namely states that satisfy the Hadamard property. We shall discuss the existence of these states also in relation to the problem of the evolution of scalar fluctuations of the metric.

MP 11: Nichtkommutative Geometrie

Zeit: Donnerstag 14:00–15:20 Raum: M010

MP 11.1 Do 14:00 M010
Free quantum groups and their non-commutative geometry — •Andreas Thom — Mathematisches Institut der Georg-August Universität Göttingen, Bunsenstr. 3-5, 37073 Göttingen, Germany

We compute the Hochschild homology of the free orthogonal quantum group $A_o(n)$. We show that it satisfies Poincare duality and should be considered to be a 3-dimensional manifold. We study the Dirac operator related to the Casimir of the action of $O(n)$. In part, this extends work on the (more) classical q-deformations of $SU(2)$.

MP 11.2 Do 14:20 M010
Matrix Models, Noncommutative Gauge Theory and emergent Gravity — •Harold Steinacker — Fakultät für Physik, Universität Wien

Matrix Models of Yang-Mills type are studied with focus on the effective geometry. It is shown that SU(n) gauge fields and matter on general 4-dimensional noncommutative branes couple to an effective metric, leading to emergent gravity. The effective metric is reminiscent of the open string metric, and depends on the dynamical Poisson structure. Covariant equations of motion are derived, which are protected from quantum corrections due to an underlying Noether theorem. The quantization is discussed qualitatively, which singles out the IKKT model as a candidate for a quantum theory of gravity coupled to matter. UV/IR mixing plays a central role. A mechanism for avoiding the cosmological constant problem is exhibited.

MP 11.3 Do 14:40 M010
Noncommutative geometry and its application to the standard model — •Pierre Martinetti — Georg-August Universität, Göttingen

We shall give an overview of the description of the standard model of particle physics minimally coupled to gravity within the framework of noncommutative geometry. Especially we shall study in detail the metric structure of spacetime that emerges from the spectral triple recently proposed by Chamseddine, Connes and Marcolli.

Within this framework points of spacetime acquire an internal structure inherited from the gauge group of the standard model. A distance is defined on this generalized spacetime which is fully encoded by the Yang-Mills gauge fields together with the Higgs field.

We will focus on some explicit examples, underlying the link between this distance and other distances well known by physicst and mathematicians, such has the Carnot-Carathéodory horizontal distance or the Monge-Kantorovitch transport distance.

MP 11.4 Do 15:00 M010
Symmetry Reduction in Twisted Noncommutative Gravity with Applications to Cosmology and Black Holes — •Alexander Schenkel and Thorsten Ohl — Lehrstuhl für Theoretische Physik II, Universität Würzburg, 97074 Würzburg, Deutschland

Noncommutative Riemannian geometry is an attractive mathematical tool for constructing modifications of Einsteins theory of general relativity. One particular approach is to deform the symmetries of gravity, i.e. the diffeomorphisms, into a noncocommutative Hopf algebra and establish a gravity theory based on these deformed symmetries. Having such a deformed theory, it is of great importance to understand symmetry reduction in this framework in order to apply it to physical problems, like e.g. cosmology or black holes.

In this presentation we will focus on twisted noncommutative gravity theories constructed by abelian twists and discuss symmetry reduction in these models. We will apply the formalism to FRW cosmology and black holes and classify all possible models for this particular class of twists. As one result we obtain isotropic twists for FRW universes and twists of black holes, which are invariant under all classical black hole symmetries.

MP 12: Quantenfeldtheorie und Kosmologie

Zeit: Donnerstag 16:00–17:00 Raum: M010

MP 12.1 Do 16:00 M010
A novel point of view on the conformal anomaly for quantised Dirac fields — •Claudio Dappiaggi, Thomas-Paul Hack, and Nicola Pinamonti — II. Institut fuer Theoretische Physik - Universitaet Hamburg

One of the main and many lessons we learned from the study of scalar fields on globally hyperbolic backgrounds, is that we can account for the so-called quantum trace anomaly employing a modified version of the classical stress-energy tensor as well as a point-splitting regularization by means of an Hadamard bidistribution. In this talk we will show that such approach can be traded to Dirac fields yielding a similar result. Particularly we shall try to emphasize, that, although we are reproducing already known results, this point of view is, on the one hand, conceptually rigorous and clear while, on the other hand, it opens the road to possible applications in a cosmological scenario.

MP 12.2 Do 16:20 M010
The new ekpyrotic ghost — Renata Kallosh[2], •Jin U Kang[1,3], Andrei Linde[2], and Viatcheslav Mukhanov[1] — [1]Arnold-Sommerfeld-Center for Theoretical Physics, Department of Physics, Ludwig-Maximilians-Universitaet Muenchen, Theresienstrasse 37, D-80333 Munich Germany — [2]Department of Physics, Stanford University, Stanford, CA 94305, USA — [3]Department of Physics, Kim Il Sung University, Pyongyang, DPR. Korea

The new ekpyrotic scenario attempts to solve the singularity problem by involving violation of the null energy condition in a model which combines the ekpyrotic/cyclic scenario with the ghost condensate theory and the curvaton mechanism of production of adiabatic perturbations of metric. The Lagrangian of this theory, as well as of the ghost condensate model, contains a term with higher derivatives, which was added to the theory to stabilize its vacuum state. We found that this term may affect the dynamics of the cosmological evolution. Moreover, after a proper quantization, this term results in the existence of a new ghost field with negative energy, which leads to a catastrophic vacuum instability. We explain why one cannot treat this dangerous term as a correction valid only at small energies and momenta below some UV cut-off, and demonstrate the problems arising when one attempts to construct a UV completion of this theory.

MP 12.3 Do 16:40 M010

Cosmological Particle Creation in States of Low Energy — •Andreas Degner — Institut für Theoretische Physik, Universität Leipzig

For the quantized linear scalar field on Friedman-Robertson-Walker spacetimes, states of low energy provide a well-motivated class of reference states. The low-energy property is approximately localized at some value of the cosmological time parameter. We present calculations of the relative particle production between a state of low energy at early time and another such state at later time. In an exponentially expanding universe, we find that the particle production may show oscillations with respect to the energy modes. The basis of the method for calculating the relative particle production is, in contrast to previously investigated approaches, completely rigorous. Approximations are only used at the level of numerical calculation.

MP 13: Quantenfeldtheorie 2

Zeit: Donnerstag 17:30–18:30 Raum: M010

MP 13.1 Do 17:30 M010

Spectral theory of translation automorphisms in QFT — •Wojciech Dybalski — University of Göttingen, Germany

The decomposition of the spectral measure of a Hamiltonian into its pure point, absolutely continuous and singular continuous parts is crucial for the formulation and resolution of the problem of asymptotic completeness in quantum mechanics. Therefore, a deeper understanding of particle aspects in quantum field theory requires the development of a similar, detailed spectral theory of translation automorphisms. Such a theory is presented in this talk and illustrated by several examples. Its applications to the problem of particle interpretation in QFT are discussed.

MP 13.2 Do 17:50 M010

Pole structure of higher correlation functions in 4D globally conformal invariant quantum field theory — •Marcel Bischoff — Institute of Theoretical Physics, Göttingen, Germany

Assuming global conformal invariance of Wightman functions has far reaching implications, e.g. such functions are rational. The twist two contribution of the operator product expansion of a pair of scalar fields of equal scaling dimension in 4 space-time dimension gives rise to a bi-field which is harmonic in both arguments. That in turn strongly restrains the admissible pole structures. We characterize possible pole structures which cannot be realized by free field constructions.

MP 13.3 Do 18:10 M010

Analysis of the twist two part of conformally invariant correlation functions — •Ingo Wagner — Institut für Theoretische Physik, Göttingen, Deutschland

We study correlation functions within the setting of globally conformal invariant quantum field theories in four dimensional spacetime. The correlation functions can be expanded in terms of partial waves that are labeled by two quantum numbers called twist and spin. From this one can obtain information about the field content of conformal theories. We will focus on the twist two part of these expansions for the four point and six point correlation functions, where the partial waves are solutions of a system of three partial differential equations.

MP 14: Alternative Ansätze

Zeit: Donnerstag 18:50–19:50 Raum: M010

MP 14.1 Do 18:50 M010

Genaueres Messen von Antigravitation durch kaskadierte, gegenläufige Präzession — •Peter Kümmel — Amselweg 15 c; 21256 Handeloh

Durch gegenläufige Rotation von identischen homogenen Kreiselmassen, so schnell und dicht beieinander angeordnet wie möglich, entsteht "Künstlicher Schwerpunktversatz" des Kreiselsystems. Wegen geringer Ablenkungswerte der Kraft- bzw. Feldlinienausbreitungen, die aber dennoch ungleich Null sind, werden Verstärkungen erforderlich. Beim Steigern der Versatzwerte sind dem Erhöhen der Rotationsmassendichte und der Drehzahlen Grenzen gesetzt. Das Anordnen der zwei Kreisel in je einem System, das den einzelnen Kreisel mehrdimensional rotieren lässt, stellt die einzige Möglichkeit zum Verlängern der Schwerpunktversatzstrecke dar. Ein Kreisel kann durch entsprechende Kardanringantriebe als Kernmasse in einer "Kaskade" dreidimensional rotiert werden. Zur weiteren Verstärkung kann eine Kaskade für eine nächst größere Kaskade als Kernmasse dienen. Wegen auftretender Präzessionserscheinungen wächst der zu investierende Kraftaufwand beträchtlich an, aber das Resultat vergrößert sich dementsprechend. Zur Ergebnisoptimierung sind Verschachtelungen beliebig vieler Kaskaden möglich. Vgl. Ref.-Nr. ISBN: 3-921291-05-4

MP 14.2 Do 19:10 M010

Atomare Spektralserien berechnet aus relativistischem Billardstoß und modifiziertem Keimzellen-Modell — •Manfred Kunz[1] und Norah Kunz[2] — [1]Postfach 860543 81632 München — [2]Postfach 860543 81632 München

Ohne Bezugnahme auf Planck, Bohr und die Wellenfunktion werden Atombindungen und Übergangsenergien berechnet. Dazu ist weder eine reziproke Frequenz als Zeit noch eine DeBroglie-Wellenlänge erforderlich. Lediglich die Grundgröße Masse und deren Relativität sowie die Feinstrukturkonstante werden gebraucht. Vorausgesetzt wird der gerade elastische Zweiteilchenstoß mit einem ruhenden Teilchen. Die Erhaltungssätze für Energie und Impuls führen zwangsläufig bei dem als Billardstoß bezeichneten Vorgang mit ganzen Zahlen zu Spektralserien, was seit über einhundert Jahren nicht bemerkt wurde. Ganzzahlige Massen M, m und Geschwindigkeiten k, n führen zu Zahlenwerten, die identisch mit denen der Rydberg-Serien sind. Die Stoßergebnisse der anfangs stillstehenden Masse und deren späterer Impuls verkörpern das Photon. Der andere Stoßpartner repräsentiert die Atombindung vor und nach dem Stoß. Die obige Relation M / m = (k+n) / (k-n) zerfällt aus physikalischen Gründen in zwei Formeln für die Bestimmung der Massen mittels M=k+n und m=k-n. Diese Massenformeln und die Impulsgleichung für den Billardstoß sind Bestimmungsgleichungen, die die Energie implizit enthalten. Wenngleich die Berechnung einfach ist, so gestaltet sich die Einordnung dieser eindimensionalen Impulswelt in die heutige Atomvorstellung als schwierig. Ein Vergleich mit einer modifizierten Keimzellteilung ist hilfreich.

MP 14.3 Do 19:30 M010

Von Archimedes zur Quanten-Kosmologie — •Norbert Sadler — Wasserburger Str. 25a; 85540 Haar

Aus den Erkenntnissen der "Sandexperimente" des Archimedes von Syrakus (287-212 v. Chr.)können die fraktalen Zustände des gegenwärtigen Universums und des Quantenraumes erkannt und bewiesen werden.

Das von Archimedes gefundene 2/3-Verhältnis von Kugel- zu Zylindervolumen kann quantentheoretisch als Wahrscheinlichkeitsamplitude für die Observation einer Kugel-Entität im Zylindervolumen, bei maximaler Entropie, aufgefasst werden. Die Wahrscheilichkeitsdichte für eine Observation beträgt demnach 4/9, in jeder Metrik. Die mittlere lineare Dichte des Univers.beträgt 4/9Protonen auf 1m,5/9 m sind Mat.frei. Der physikal.Zustand des expandierenden Univ. ist fraktal dem Zust. zum Zeitpunkt d.Quant.Fluktuat.vor

sinh41,4 sec.
frakt. Zust. des Univ. = Zust. zum Zeitp.d. Quant.Flukt. Zust.d.Univ=(HubbleParam.*1s)/(5/9)=1/(5/9**2*E8LieGrp.); Zust.d.Quant.Flukt.=SQRT(2*(4/9)*Betr.l(Pl))=stat.Fehler der Dispersionslänge bei d. Flukt.Die math.physik.Relat.: (Pi/e-Funkt.)=(4/9)*(Feinstrukt.Konst.)/(CP-Verletzung).