Fachverband Theoretische und Mathematische Grundlagen der Physik (MP)

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Übersicht der Hauptvorträge und Fachsitzungen

(Hörsaal ZHG 003)

Hauptvorträge

MP 4.1	Di	14:15–14:55	ZHG 003	**Delocalization through resonances: the Anderson transition on trees** — •Simone Warzel
MP 6.1	Di	16:30–17:10	ZHG 003	**New light on infrared problems: Sectors, statistics, spectrum and all that** — •Detlev Buchholz
MP 16.1	Do	14:15–14:55	ZHG 003	**Information theory in a quantum world** — •Michael Wolf

Hauptvorträge des fachübergreifenden Symposiums SYSY (Mi 14:00-16:20, ZHG 011)

Das vollständige Programm dieses Symposiums ist unter SYSY aufgeführt.

SYSY 1.1	Mi	14:00–14:35	ZHG 011	**Supersymmetrie zwischen TeV-Skala und GUT-Skala** — •Wilfried Buchmüller
SYSY 1.2	Mi	14:35–15:10	ZHG 011	**Suche nach Supersymmetrie am LHC** — •Johannes Haller
SYSY 1.3	Mi	15:10–15:45	ZHG 011	**Black Holes in String Theory** — •Mirjam Cvetic
SYSY 1.4	Mi	15:45–16:20	ZHG 011	**Superstrings, Gauge Theory and Supermagnets** — •Volker Schomerus

Fachsitzungen

MP 1.1–1.3	Di	9:15–10:30	ZHG 003	**Quanteninformation I**
MP 2.1–2.1	Di	11:00–11:45	ZHG 011	**Plenarvortrag 1: G. Herten, LHC Highlights**
MP 3.1–3.1	Di	11:45–12:30	ZHG 011	**Plenarvortrag 2: M. Ansorg, Rotierende relativistische Sterne**
MP 4.1–4.1	Di	14:15–14:55	ZHG 003	**HV Quantenmechanik: S. Warzel**
MP 5.1–5.2	Di	15:00–15:50	ZHG 003	**Quantenmechanik**
MP 6.1–6.1	Di	16:30–17:10	ZHG 003	**HV Quantenfeldtheorie: D. Buchholz**
MP 7.1–7.2	Di	17:15–18:05	ZHG 003	**Quantenfeldtheorie**
MP 8.1–8.2	Mi	8:45– 9:35	ZHG 003	**Gravitation und Quantenfelder**
MP 9.1–9.1	Mi	9:40–10:05	ZHG 003	**Gravitation**
MP 10.1–10.4	Mi	14:00–16:20	ZHG 011	**Symposium Supersymmetrie**
MP 11.1–11.4	Mi	16:45–18:45	ZHG 002	**HV: Schwarze Löcher und Felder (gemeinsam mit GR)**
MP 12.1–12.2	Do	8:45– 9:35	ZHG 003	**Quantengravitation**
MP 13.1–13.2	Do	9:40–10:30	ZHG 003	**Offene Quantensysteme**
MP 14.1–14.1	Do	11:00–11:45	ZHG 011	**Plenarvortrag 3: M. Spradlin, Scattering amplitudes**
MP 15.1–15.1	Do	11:45–12:30	ZHG 011	**Plenarvortrag 4: J. Kopp, Die fehlenden 95%**
MP 16.1–16.1	Do	14:15–14:55	ZHG 003	**HV Quanteninformation: M. Wolf**
MP 17.1–17.2	Do	15:00–15:50	ZHG 003	**Quanteninformation II**
MP 18.1–18.1	Do	15:55–16:20	ZHG 003	**Klassische Physik**
MP 19.1–19.1	Di	9:00–19:00	ZHG 003	**Poster (durchgehend Di - Do)**

Mitgliederversammlung Fachverband Theoretische und Mathematische Grundlagen der Physik

Dienstag 18:15–19:00 ZHG 003 Tagesordnung: siehe http://www.dpg-physik.de/dpg/gliederung/fv/mp/tagungen.html

MP 1: Quanteninformation I

Zeit: Dienstag 9:15–10:30 Raum: ZHG 003

MP 1.1 Di 9:15 ZHG 003

Generalized Dicke States — •Stephan Hartmann — TiLPS, Tilburg University, Tilburg, The Netherlands

Quantum master equations are an important tool in quantum optics and quantum information theory. For systems comprising a small to medium number of atoms (or qubits), the non-truncated equations are usually solved numerically. We present a group-theoretical superoperator method that helps solving these equations. To do so, we exploit the SU(4)-symmetry of the Lindblad operator and construct basis states that generalize the well-known Dicke states. This allows us to solve various problems analytically and to considerably reduce the complexity of problems that can only be solved numerically. Finally, we present three examples that illustrate the proposed method.

MP 1.2 Di 9:40 ZHG 003

Renormalization Group and Continuum Limit of Quantum Cellular Automata — •Zoltan Zimboras — Quantum Information Theory Group, ISI, Torino

We develop a renormalization group formalism for Quantum Cellular Automata (reminiscent of the algebraic renormalization group of Buchholz and Verch). Using this formalism, we can define the continuum limit for certain automata. As a particular example, we show that the continuum limit of the so-called "Glider Clifford Cellular Automaton" is the 1+1 dimensional relativistic QFT of free majorana fermions.

MP 1.3 Di 10:05 ZHG 003

Quantum fluctuations, mean field methods and the simulation of continuous quantum systems — Zoltán Kádár, •Michael Keyl, and Zoltán Zimborás — ISI Foundation, Torino, Italy

The fluctuations of a discrete quantum system behave in the infinite particle limit like a continuous system. This fact can be used to simulate a continuous system in terms of finitely many qubits. Experimental applications of this observation include the implementation of "quantum memory", which can be used to store the state of (one mode) of a light field in an atomic ensemble at room temperature. A very convenient tool to treat such models is mean field theory, where the fluctuations around a mean field observable are described in terms of "fluctuation operators". In this context we will show how products of the latter converge in a weak sense to polynomials of position and momentum of the continuous system. Based on that the relation between discreet and continuous dynamics will be analyzed, and quadratic Hamiltonians are discussed in greater detail. Finally we will have a particular look at cases where the continuous Hamiltonian is a Schrödinger operator which does not admit a selfadjoint extension.

MP 2: Plenarvortrag 1: G. Herten, LHC Highlights

Zeit: Dienstag 11:00–11:45 Raum: ZHG 011

Plenarvortrag MP 2.1 Di 11:00 ZHG 011

LHC Highlights — •Gregor Herten — Physikalisches Institut, Universität Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg

Die wichtigsten technologischen und physikalischen Höhepunkte des LHC werden vorgestellt. Dazu gehören die äußerst erfolgreiche Datennahme in 2001, bei der die Experimente deutlich mehr Ereignisse als erwartet aufnehmen konnten, und die vielfältigen Physikanalysen. Mit einer integrierten Luminosität von bis zu 5/fb sind genaue Überprüfungen des Standardmodells möglich, z.B. in der Bottom- und Top-Physik, der Produktion von Eichbosonen und Jets und bei der Suche nach dem Higgs-Boson. In einem breiten Spektrum von Endzuständen wurden Suchen nach neuen Effekten, die über das Standardmodell hinausweisen, durchgeführt. Mit den neuen LHC Ergebnissen ist die Teilchenphysik in eine spannende Phase eingetreten, beflügelt von der Hoffnung, dass die Messungen den Weg für die weitere Entwicklung der Teilchenphysik weisen werden.

MP 3: Plenarvortrag 2: M. Ansorg, Rotierende relativistische Sterne

Zeit: Dienstag 11:45–12:30 Raum: ZHG 011

Plenarvortrag MP 3.1 Di 11:45 ZHG 011

Klassen starr rotierender relativistischer Sterne im Gleichgewicht — •Marcus Ansorg — Max-Wien-Platz 1, 07743 Jena, Germany

Das Studium der physikalischen Eigenschaften rotierender astrophysikalisch relevanter Körper (wie Neutronensterne und Schwarze Löcher), die unter dem Einfluss ihrer Eigengravitation zusammengehalten werden, hat eine lange Geschichte. Bedeutende Physiker und Mathematiker, unter ihnen Newton, Maclaurin, Jacobi, Liouville, Riemann und Poincare, haben wichtige Beiträge geleistet. Heute gestatten hochgenaue numerische Methoden die Untersuchung der verschiedenen Arten von starr rotierenden relativistischen Sternen im Gleichgewicht. Es zeigt sich, dass diese Sterne in bestimmte Klassen eingeteilt werden können, die Figuren unterschiedlicher Topologie umfassen.

In diesem Vortrag beschreiben wir die Entwicklung dieses Gebietes, diskutieren die in diesem Kontext zu lösenden mathematischen Gleichungen mit ihren Randbedingungen und gehen insbesondere auf den Newtonschen sowie den ultra-relativistischen Limes eines Schwarzen Lochs ein.

MP 4: HV Quantenmechanik: S. Warzel

Zeit: Dienstag 14:15–14:55 Raum: ZHG 003

Hauptvortrag MP 4.1 Di 14:15 ZHG 003

Delocalization through resonances: the Anderson transition on trees — •Simone Warzel — Fine Hall, Princeton University — Zentrum Mathematik, TUM

Motivated by the quest for a theory of quantum transport in disordered media, in 1958 P.W. Anderson came up with a model for a quantum particle in a random energy landscape. Among its interesting features is a conjectured sharp transition from a regime of localized eigenstates to one of diffusive transport. Until today it remains a mathematical challenge to establish these features in the framework of random Schrödinger operators.

In this talk, I will describe recent progress in the understanding of the spectral and dynamical properties of such operators in case the underlying configuration space is hyperbolic such as a tree graph. Among the surprising phenomena which we discover is that even at weak disorder the regime of diffusive transport extends well beyond the one of the graph Laplacian into the regime of Lifshitz tails. As will be explained in the lecture, the mathematical mechanism for the appearance of conducting states in this non-perturbative regime are disorder-induced resonances.

MP 5: Quantenmechanik

Zeit: Dienstag 15:00–15:50 Raum: ZHG 003

MP 5.1 Di 15:00 ZHG 003

Anderson-Übergang in einer Klasse zufälliger dünnbesetzter Modelle bei $d \geq 2$ Dimensionen — Domingos Marchetti[1] und •Walter Wreszinski[2] — [1]Departamento de Física Geral, Instituto de Física, Universidade de São Paulo, São Paulo, Brasilien — [2]Departamento de Física Matemática, Instituto de Física, Universidade de São Paulo, Brasilien

Wir zeigen dass die Kronecker-Summe über $d \geq 2$ Kopien einer zufälligen ein-dimensionalen Jacobi-Matrix einen Spektralübergang von der von P. W. Anderson vorgeschlagenen Art aufweist: vom absolut stetigen Spektrum um das Zentrum des Bandes, zum reinen Punktspektrum um die Ränder. Offene Probleme, sowie eine mögliche Anwendung (der für $d \geq 2$ vorhandene Übergang bei leicht dotierten Halbleitern) werden kurz diskutiert. Die Methoden, von den Autoren in Nonlinearity 20, 765-787 (2007) ursprünglich eingeführt, stützen sich auf Ergodentheorie, Dynamische Systeme und Funktionalanalysis. [arXiv 1106.4852], erscheint in J. Stat. Phys.

MP 5.2 Di 15:25 ZHG 003

Magnetic Symmetries and Applications to Solid State Physics — Giuseppe De Nittis[1] and •Max Lein[2] — [1]LAGA, Institut Galilée, Université Paris 13, 99, avenue J.-B. Clément, F-93430 Villetaneuse, France. — [2]Universität Tübingen, Mathematisches Institut, Auf der Morgenstelle 10, 72076 Tübingen

In a recent publication (J. Math. Phys. 52, 112103 (2011)), magnetic symmetries were the crucial ingredient in showing the existence of an exponentially localized Wannier basis in the presence of magnetic fields.

The hamiltonian $H = P^2 + V$ has symmetry U if $[H, U] = 0$ where U is a unitary or anti-unitary operator. For a wide range of symmetries, we can systematically associate a magnetic symmetry $U^A = \lambda^A U$ which commutes with $H^A = (P - A)^2 + V$, i.e. $[H^A, U^A] = 0$ holds whenever $[H, U] = 0$. Here, λ^A is a phase factor that can be written as the exponential of a path integral involving the vector potential A. In particular, we can "magnetize" Galilean symmetries, including magnetic rotations and magnetic time-reversal. We reckon that magnetic symmetries may be a useful tool in other applications.

MP 6: HV Quantenfeldtheorie: D. Buchholz

Zeit: Dienstag 16:30–17:10 Raum: ZHG 003

Hauptvortrag MP 6.1 Di 16:30 ZHG 003

New light on infrared problems: Sectors, statistics, spectrum and all that — •Detlev Buchholz — Institut für Theoretische Physik, Universität Göttingen

Within the setting of local quantum physics, a new approach to the general analysis of the physical state space of a theory is presented which covers theories with long range forces, such as QED. Making use of the notion of charge class, which generalizes the concept of superselection sector, infrared problems are avoided. Based on it the proper charge content of a theory, the statistics of the corresponding states and their spectral properties can be determined and classified in a systematic manner. A key ingredient in this approach is the insight that inevitable experimental limitations provide a natural **geometric** infrared cutoff. The results shed new light on the traditional concept of superselection rule and may also be of relevance for a deeper understanding of the phenomenon of quantum decoherence.
(Joint work with S. Doplicher and J.E. Roberts)

MP 7: Quantenfeldtheorie

Zeit: Dienstag 17:15–18:05 Raum: ZHG 003

MP 7.1 Di 17:15 ZHG 003

The ABJ anomaly in regularized gauge theories — •Benjamin Lévêque and Christoph Kopper — Centre de Physique Theorique, Ecole polytechnique

We analyse the triangular anomaly in Pauli-Villars regularized axial U(1) gauge theory and within the Standard Model, using well-defined euclidean functional integrals. In axial U(1) gauge theory, we prove the presence of the anomaly and explain its relation to the IR non-analyticity of the fermion triangle. In the electroweak sector of the Standard Model, we confirm the cancelation of the anomaly to one-loop order in the regularized theory. We expose the theoretical tools based on which we aim to extend this result to all loop orders.

MP 7.2 Di 17:40 ZHG 003

Characterization of local operators in factorizing scattering models — •Daniela Cadamuro[1] and Henning Bostelmann[2] — [1]Institute for Theoretical Physics, Göttingen, Germany — [2]Department of Mathematics, York, UK

Lechner has given in 2006 an abstract existence proof for interacting quantum field theories, using a novel approach for a large class of models in two dimensions. We supplement this result by an explicit characterization of the local observables in these theories. We have established how local observables can be described in terms of an infinite hierarchy of holomorphic functions, and analysed the recursive system of relations among these functions. We have formulated a theorem that gives the complete characterization, and outline the general strategy for its proof, preparing all its ingredients.

MP 8: Gravitation und Quantenfelder

Zeit: Mittwoch 8:45–9:35 Raum: ZHG 003

MP 8.1 Mi 8:45 ZHG 003

The Casimir effect in minimal length theories — •Antonia Micol Frassino[1] and Orlando Panella[2] — [1]Frankfurt Institute for Advanced Studies — [2]INFN Università di Perugia

We start by a brief review of the Casimir effect. Then we study how this effect is sensible to the smaller structure of spacetime. To achieve this, we model spacetime granularity by the presence of a minimal length implemented through a generalized uncertainty principle. We find that the quantization of the electromagnetic field is affected by the minimal length: specifically, fields can be only expanded on a set of maximally localized states that regularize the UV region of the theory. In this context we compute the lowest order correction in the minimal length parameter to the Casimir energy. We find that the correction is still attractive and scales with the fifth power of the distance beetwen the plates. We make some considerations about the possibility of observing this effect. Future developments will be suggested.

MP 8.2 Mi 9:10 ZHG 003

Quantum field theory on locally noncommutative spacetimes — •Gandalf Lechner[1] and Stefan Waldmann[2] — [1]Institut für Theoretische Physik, Uni Leipzig — [2]Leuven University

A class of spacetimes which are noncommutative only in a prescribed region is presented. These spacetimes are obtained by a generalization of Rieffel's deformation procedure to deformations of locally convex algebras and modules by smooth polynomially bounded $\mathbb{R}^n$-actions with compact support. Extending previous results of Bahns and Waldmann, it is shown how to perform such deformations in a strict sense. Some results on quantum fields propagating on locally noncommutative spacetimes are also given.

MP 9: Gravitation

Zeit: Mittwoch 9:40–10:05 Raum: ZHG 003

MP 9.1 Mi 9:40 ZHG 003

The variant of post-Newtonian mechanics with generalized fractional derivatives — •Vladimir Kobelev — Fakultät IV: Naturwissenschaftlich-Technische Fakultät, Universität Siegen, 57076 Siegen

We investigate mathematically the variant of post-Newtonian mechanics using generalized fractional derivatives. The relativistic-covariant generalization of the classical equations for weak gravitational feld is studied. The equations (i) match the weak Newtonian limit on the moderate scales and (ii) deliver a potential distinct from the Newtonian on certain large-distance characteristic scales. The exact expression for fundamental solution is found. With the fundamental solution closed analytical form for virial theorem is stated.

MP 10: Symposium Supersymmetrie

Zeit: Mittwoch 14:00–16:20 Raum: ZHG 011

Plenarvortrag MP 10.1 Mi 14:00 ZHG 011

Supersymmetrie zwischen TeV-Skala und GUT-Skala — •Wilfried Buchmüller — DESY, Notkestr. 85, 22607 Hamburg

Supersymmetrie ist von zentraler Bedeutung in Theorien, die elektroschwache und starke Wechselwirkungen bei TeV Energien auf eine einzige Wechselwirkung bei der GUT-Skala von 10^{13} TeV zurückführen. Erste Resultate vom Large Hadron Collider (LHC) liefern bereits wichtige Hinweise auf Realisierung und Brechung der Supersymmetrie.

Plenarvortrag MP 10.2 Mi 14:35 ZHG 011

Suche nach Supersymmetrie am LHC — •Johannes Haller — Universität Hamburg

Supersymmetrische Theorien stellen eine besonders interessante Möglichkeit zur Erweiterung des Standardmodells der Teilchenphysik dar. Insbesondere supersymmetrische Theorien an der Teraskala können einige Probleme des SM auflösen. Die sich ergebenden neuen Teilchenzustände können in hochenergetischen Teilchenkollisionen, wie sie in Collider-Experimenten aufgezeichnet werden, produziert und nachgewiesen werden.

Mit großen Erwartungen, insbesondere an die Suche nach Supersymmetrie und anderen Theorien neuer Physik, hat vor zwei Jahren der Betrieb des Large-Hadron-Colliders (LHC) mit der Vermessung von hochenergetischen pp-Kollisionen begonnen. Diese Daten werden genutzt, um nach Signalen von Supersymmetrie und neuer Physik zu suchen. Im Vortrag werden die Herausforderungen und Methoden sowie die experimentellen Ergebnisse der bisherigen Suche nach Supersymmetrie am LHC besprochen und die sich daraus ergebenden Einschränkungen des Parameterraumes erläutert. Auch die Erwartungen an zukünftige Datennahmeperioden mit noch größeren Datensätzen und höheren Schwerpunktsenergien werden diskutiert.

Plenarvortrag MP 10.3 Mi 15:10 ZHG 011

Black Holes in String Theory — •Mirjam Cvetic — University of Pennsylvania, Philadelphia, U.S.A.

We review properties of multi-charged rotating black holes in asymptotically Minkowski and anti-deSitter space-times, as solutions of maximally supersymmetric compactifications of String Theory. We focus on recent progress in deriving the conformal invariance and the microscopics of general, asymptotically flat rotating black holes in four- and five-dimensions.

Plenarvortrag MP 10.4 Mi 15:45 ZHG 011

Superstrings, Gauge Theory and Supermagnets — •Volker Schomerus — DESY Theory, Hamburg, Germany

Gauge theories have enormous success in explaining many of the features of our world, though often theorists struggle to extract physics from the microscopic models. Over the last decade, string theorists discovered intriguing dual gravitational descriptions. In supersymmetric versions of QCD, such geometric formulations of conventional gauge theories have already provided novel non-perturbative expressions for quantities that seemed inaccessible through the usual perturbative techniques.

MP 11: HV: Schwarze Löcher und Felder (gemeinsam mit GR)

Zeit: Mittwoch 16:45–18:45 Raum: ZHG 002

Hauptvortrag MP 11.1 Mi 16:45 ZHG 002

On the Consistency of Classical and Quantum Supergravity Theories — •Thomas-Paul Hack[1], Mathias Makedonski[2], and Alexander Schenkel[3] — [1]II Institute for Theoretical Physics, University of Hamburg — [2]Department of Mathematical Sciences, University of Copenhagen — [3]Department of Stochastics, University of Wuppertal

It is known that pure N=1 supergravity in d=4 spacetime dimensions is consistent at a classical and quantum level, i.e. that in a particular gauge the field equations assume a hyperbolic form - ensuring causal propagation of the degrees of freedom - and that the associated canonical quantum field theory satisfies unitarity. It seems, however, that it is yet unclear whether these properties persist if one considers the more general and realistic case of N=1, d=4 supergravity theories including arbitrary matter fields. We partially clarify the issue by introducing novel hyperbolic gauges for the gravitino field and proving that they commute with the resulting equations of motion. Moreover, we review recent partial results on the unitarity of these general supergravity theories and suggest first steps towards a comprehensive unitarity proof.

Hauptvortrag MP 11.2 Mi 17:15 ZHG 002

Analytical approach to the geodesic equations in General Relativity — Victor Enolski[2,3,4], Eva Hackmann[4], •Valeria Kagramanova[1], Jutta Kunz[1], and Claus Lämmerzahl[4] — [1]Institut für Physik, Carl von Ossietzky Universität Oldenburg, 26111 Oldenburg — [2]Hanse-Wissenschaftskolleg (HWK), 27733 Delmenhorst, Germany — [3]Institute of Magnetism, 36-b Vernadsky Blvd, Kyiv 03142, Ukraine — [4]ZARM, Universität Bremen, Am Fallturm, ZARM, Universität Bremen, Am Fallturm, D-28359 Bremen, German

The motion of test particles and light is of great importance for the investigation of the physical properties of gravitational fields since only matter and light can be observed. There are two main methods to solve

the geodesic equations: analytical and numerical. Analytical solutions deliver an exact solution of the equations of motion, have arbitrary accuracy and allow to investigate the properties of the motion and hence of the gravitating body itself in detail. In this talk we present the analytical solution of the geodesic equation in many well-known black hole space-times. In particular, in the Plebanski-Demianski space-time of generalized black holes. The solution is expressed in terms of the Weierstrass' elliptic or Abelian hyperelliptic functions. That depends on the degree of difficulty of the considered problem and on the number of parameters characterizing the black hole and the test particle. We integrate differentials of all three kind with arbitrary genus of the underlying polynomial curve. We also present the analytical expressions for the observable quantities such as perihelion shift for planetary orbits and light deflection for escape orbits of photons.

Hauptvortrag MP 11.3 Mi 17:45 ZHG 002

Black holes in su(N) Einstein-Yang-Mills theory: hair, fur and superconducting horizons — •Elizabeth Winstanley — Consortium for Fundamental Physics, School of Mathematics and Statistics, The University of Sheffield, Hicks Building, Hounsfield Road, Sheffield. S3 7RH United Kingdom

Black hole solutions of general relativity coupled to an su(N) Yang-Mills gauge field have been studied for over 20 years. In this talk we focus on black holes in Einstein-Yang-Mills theory in four-dimensional, asymptotically anti-de Sitter space, with a negative cosmological constant. We emphasize three aspects of these black holes:

(a) the existence of stable black holes in anti-de Sitter space with abundant Yang-Mills hair;

(b) how these hairy black holes may be characterized by non-Abelian charges at infinity;

(c) planar black holes with superconducting horizons.

Hauptvortrag MP 11.4 Mi 18:15 ZHG 002

Bidifferential calculus and integrable PDEs in General Relativity — •Folkert Müller-Hoissen — Max-Planck-Institute for Dynamics and Self-Organization, Bunsenstrasse 10, D-37073 Göttingen

The "bidifferential calculus approach" to integrable partial differential (and difference) equations allows to deduce substantial results, e.g. methods to generate exact solutions, on an abstract level. Once a "bidifferential calculus formulation" of some equation is at hand, these general results can be evaluated in the concrete case. A special result in this framework, with a surprisingly simple proof, has recently been shown (joint work with Aristophanes Dimakis and Nils Kanning) to reproduce in particular the multi-Kerr-NUT and multi-Demianski-Newman families of solutions of the Ernst equations, governing stationary axisymmetric vacuum and electrovacuum space-times in General Relativity. We present an introduction to the underlying structures and methods of bidifferential calculus, and delegate a more detailed discussion of the case of the Ernst equations to the talk by Nils Kanning at this meeting.

MP 12: Quantengravitation

Zeit: Donnerstag 8:45–9:35 Raum: ZHG 003

MP 12.1 Do 8:45 ZHG 003

Discrete quantum field theories of the gravitational field — •Gennaro Tedesco — Georg-August-Universität Göttingen, Göttingen, Germany.

We introduce a procedure of quantization for the gravitational field by taking a lattice regularization of the space-time in terms of graphs labelled by representations of the symmetry groups. A quantum field theory for the gravitational field, namely the Group Field Theory, is also provided.

MP 12.2 Do 9:10 ZHG 003

Locally covariant field theory as an approach to quantum gravity — •Katarzyna Rejzner — 2. Institut für Theoretische Physik, Hamburg, Deutschland

I will present recent results concerning the program proposed by Brunetti and Fredenhagen in 2005, to formulate perturbative quantum gravity in the framework of locally covariant field theory. In particular, I will discuss the problem of finding diffeomorphism invariant observables and the background independence.

MP 13: Offene Quantensysteme

Zeit: Donnerstag 9:40–10:30 Raum: ZHG 003

MP 13.1 Do 9:40 ZHG 003

Differential Geometry of Coherently Controlled Markovian Open Quantum Systems — •Corey O'Meara[1], Gunther Dirr[2], and Thomas Schulte-Herbrüggen[1] — [1]TU-Munich, Dept. Chem. — [2]University of Würzburg, Inst. Math.

We extend standard Markovian unital and non-unital quantum channels by allowing for coherent Hamiltonian controls. We show that the geometry of these controlled channels can be described in terms of *Lie (sub)semigroups* in a way [1] that is more helpful for control engineering than the usual picture of Lindblad and Kossakowski. For standard dissipative interactions with the environment (phase damping, depolarizing, amplitude damping etc) and different coherent controls, we specify the tangent cones (Lie wedges) to the Lie semigroups [2].

These cones are the counterpart of the infinitesimal generator of a single one-parameter semigroup. They comprise all directions the open quantum system can be steered along. Being readily scalable to multi-qubit systems, such a differential characterisation is highly valuable for approximating reachable sets of given initial quantum states in a plethora of experimental implementations. The advantage over estimates by majorisation even increases with system size.

References:

[1] G. Dirr, U. Helmke, I. Kurniawan, and T. Schulte-Herbrüggen, Rep. Math. Phys. 64 (2009) 93–121 [doi:10.1016/S0034-4877(09)90022-2]

[2] C. O'Meara, G. Dirr, and T. Schulte-Herbrüggen, IEEE Trans. Control, in press (2011), [see: http://arxiv.org/abs/1103.2703v2]

MP 13.2 Do 10:05 ZHG 003

Mappings of open quantum systems onto chain representations and Markovian embeddings — •M.P. Woods[1,2], R. Groux[3], A.W. Chin[1], S.F. Huelga[1], and M.B. Plenio[1,2] — [1]Institut für Theoretische Physik, Universität Ulm, D-89069 Ulm, Germany — [2]QOLS, Blackett Laboratory, Imperial College London, SW7 2BW, United Kingdom — [3]Lycee Polyvalent Rouviere, Rue Sainte Claire Deville. BP 1205, 83070 Toulon, France

This talk is concerned with the mapping of the Hamiltonian of open quantum systems onto chain representations, which forms the basis for a rigorous theory of the interaction of a system with its environment. This mapping progresses as an iteration which gives rise to a sequence of residual spectral densities whose properties determines the essential physical properties of the system. The rigorous mathematical properties of this mapping have been unknown so far. Here we develop the theory of secondary measures to derive an analytic, non-iterative expression for the sequence solely in terms of the initial measure and its associated orthogonal polynomials of the first and second kind. By formulating this new result in terms of a theory concerning Jacobi matrices, we find a very general connection between spectral theory and open quantum systems. These results make a significant and mathematically rigorous contribution to the understanding of the theory of open quantum systems, and paves the way towards the efficient simulation of these systems, which within the standard methods, is often an intractable problem.

A preprint is available here: http://arxiv.org/abs/1111.5262

MP 14: Plenarvortrag 3: M. Spradlin, Scattering amplitudes

Zeit: Donnerstag 11:00–11:45 Raum: ZHG 011

Plenarvortrag MP 14.1 Do 11:00 ZHG 011

On the Mathematical Structure of Scattering Amplitudes — •Marcus Spradlin — Brown University, Providence RI, USA

The past several years have seen dramatic progress in our understanding of scattering amplitudes in supersymmetric gauge and gravity theories. Theoretical advances including the discovery of hidden symmetries and rich mathematical structure have led also to practical advances which in many cases render previously impossible field theory calculations trivial. I will review these and recent related developments on correlation functions and Wilson loops, including intriguing connections between gauge theory scattering amplitudes and the mathematical theory of motives.

MP 15: Plenarvortrag 4: J. Kopp, Die fehlenden 95%

Zeit: Donnerstag 11:45–12:30 Raum: ZHG 011

Plenarvortrag MP 15.1 Do 11:45 ZHG 011

Die fehlenden 95%: Theorie und Phänomenologie der dunklen Materie und dunklen Energie — •Joachim Kopp — Fermilab, PO Box 500, Batavia, IL 60510, USA

In diesem Vortrag diskutieren wir neue Entwicklungen in der theoretischen Astroteilchenphysik, insbesondere in den Bereichen dunkle Materie und dunkle Energie. Wir werden uns ausführlich mit der theoretischen Interpretation experimenteller Resultate zur dunklen Materie beschäftigen und dabei insbesondere auf die direkte Suche in Kernrückstoßexperimenten, auf LHC-Signaturen und auf astrophysikalische Beobachtungen eingehen. Neben den klassischen Modellen wie Supersymmetrie werden wir auch Modelle mit relativ leichten neuen Teilchen weit unterhalb der elektroschwachen Skala betrachten. Diese neuen Teilchen können entweder direkt als dunkle Materie fungieren oder die Wechselwirkungen der dunklen Materie vermitteln. Für dunkle Materie im Massenbereich $\lesssim 10$ GeV besteht die interessante Möglichkeit, dass die Energiedichte der dunklen Materie im frühen Universum durch denselben Mechanismus bestimmt wird wie die Teilchen-Antiteilchen-Asymmetrie der sichtbaren Materie. Schliesslich werden wir einen kurzen Überblick über Modelle dunkler Energie jenseits der klassischen kosmologischen Konstante geben.

MP 16: HV Quanteninformation: M. Wolf

Zeit: Donnerstag 14:15–14:55 Raum: ZHG 003

Hauptvortrag MP 16.1 Do 14:15 ZHG 003

Information theory in a quantum world — •Michael Wolf — Technische Universität München, Fakultät für Mathematik

The talk reviews recent progress in quantum information theory. We will focus on the exciting interplay which we have seen in the last years between classical Shannon theory, statistical inference and pure mathematics on the one hand and quantum information theory on the other hand.

MP 17: Quanteninformation II

Zeit: Donnerstag 15:00–15:50 Raum: ZHG 003

MP 17.1 Do 15:00 ZHG 003

Mathematical Quantum Systems Theory for Engineers: Theory and Applications with a Focus on Fermions — •Thomas Schulte-Herbrüggen[1], Robert Zeier[1], Zoltan Zimboras[2], and Michael Keyl[2] — [1]TU-Munich, Dept. Chem. — [2]ISI Torino, Italy

The dynamic properties of closed (or open) quantum systems is presented in a unified way via dynamic system Lie algebras (or Lie wedges).

For the quantum engineer, these algebras (or cones) encapsulate all directions a quantum system can be steered along. This is of central importance in quantum simulation and implementation of quantum information processing. We give a number of examples including systems of spins, bosons, and in particular fermions building on [1].

Applications to controllability, reachability, and observability are given. Relations to generalising notions in the mathematical field of C-numerical ranges are pointed out, which go beyond [2, 3].

References:

[1] R. Zeier and T. Schulte-Herbrüggen, J. Math. Phys. 52 (2011) 113510 [doi:10.1063/1.3657939]

[2] T. Schulte-Herbrüggen, S. Glaser, G. Dirr, and U. Helmke, Rev. Math. Phys. 22 (2010) 597–667 [doi:10.1142/S0129055X10004053]

[3] T. Schulte-Herbrüggen et al., Lin. Multilin. Alg. 56 (2008) 3–26 [doi:10.1080/03081080701544114]

MP 17.2 Do 15:25 ZHG 003

Undecidability as a genuine quantum property — Jens Eisert[1], Markus P. Müller[2], and •Christian Gogolin[1] — [1]Dahlem Center for Complex Quantum Systems, Freie Universität Berlin, 14195 Berlin, Germany — [2]Perimeter Institute for Theoretical Physics, 31 Caroline Street North, Waterloo, ON N2L 2Y5, Canada

A famous result by Alan Turing dating back to 1936 is that a general algorithm solving the halting problem on a Turing machine for all possible inputs and programs cannot exist - the halting problem is undecidable. In this talk it will be shown that surprisingly simple problems in quantum mechanics can be undecidable in this sense, even if the corresponding classical problem is decidable. Undecidability appears here as a genuine quantum property. This gives a new twist to quantum complexity theory, which has up to now mostly been concerned with quantitative separations between quantum and classical physics in terms of hardness.

MP 18: Klassische Physik

Zeit: Donnerstag 15:55–16:20 Raum: ZHG 003

MP 18.1 Do 15:55 ZHG 003

Energieaufnahmen und Abgaben in dynamischen Systemen — •Wilhelm Engel — 85540 Haar

Massen können Energie aufnehmen und wieder abgeben. Energieaufnahme kann elektrisch mittels Bauelementen (Elektrolytkondensatoren) etc., chemisch mittels Batterien etc., thermodynamisch mittels Wärme, mechanisch z.B. durch Beschleunigung von Massen bzw. Fahrzeuge, oder auf andere Weise erfolgen. Eine aufgenommene Energie läßt sich energetisch konventionell und auch relativistisch erfassen, wobei man relativistisch zwischen Ruhemassen und bewegten Massen unterscheiden muß. Bei der späteren Abgabe und Umwandlung von innerer Energie kann die vorher gespeicherte Energie gewünschten Applikationen z.B. in der Technologie zugeführt werden, oder sie läßt sich an biolologischen Prozessen untersuchen. Dabei kommt es zu Verlusten. Hierbei ist immer die Gesamtenergie zu berücksichtigen. Verluste bei Umwandlung (Aufnahme und Abgabe von Energie) ergeben sich aus den Hauptsätzen der Thermodynamik und aus anderen physikalischen Gesetzen. Über die Effizienz bei der Aufnahme und Abgabe bzw. bei der Umwandlung von Energie soll anhand von mathematischen Betrachtungen berichtet werden.

MP 19: Poster (durchgehend Di - Do)

Zeit: Dienstag 9:00–19:00 Raum: ZHG 003

MP 19.1 Di 9:00 ZHG 003

Energie-Impuls-Relation beim Atomspektrum und beim PSE — •Manfred Kunz — Reinhardtstraße 11 04318 Leipzig

Man kann Atomspektren insbesondere bei wasserstoffähnlichen Teilchen ohne direkte Bezugnahme auf die Quantenphysik berechnen, wozu lediglich die Masse des Elektrons mit Atomkern und die Feinstrukturkonstante in einer relativistischen Interpretation gebraucht werden. Vorausgesetzt werden Teilchen oder relativistische Scheinmassen, deren Wechselwirkung unter Anwendung der Erhaltungssätze für Energie und Impuls mit ganzen Zahlen zu Spektralserien führen. Hierzu dient eine Dreiecksmatrix mit einheitlichen Gliedern. Bezeichnet man die Anzahl der Zeilen mit n, dann erfolgt der Übergang zur nächst höheren Zeile durch Kopieren der vorliegenden Dreieckszeile und durch ein symmetrisches Anfügen je eines weiteren einheitlichen Gliedes. Jede Dreieckszeile soll aus 2n-1 Gliedern bestehen, das Dreieck beinhaltet demzufolge das Quadrat von n Gliedern. Bei der Lyman-Linie 1-3 ergibt die längste Dreieckszeile als Impuls P=5. Der Gesamtinhalt des Dreiecks verkörpert die Energie E=9 Glieder. Die Größen P und E sind nicht frei wählbar. Jede Dreieckszeile lässt sich anordnen als ein räumlich übereinander liegendes Sternpolygon oder Polygon, entfernt vergleichbar mit einer Bohrschen Bahn. Die Glieder können als Punkte eines interessanten Algorithmus belebt werden. Eine simple Vorrichtung für den schulischen Gebrauch wird vorgestellt.