Fachverband Theoretische und Mathematische Grundlagen der Physik (MP)

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Übersicht der Hauptvorträge und Fachsitzungen

(Hörsaal 30.45:201)

Hauptvorträge

MP 6.1	Di	14:00–14:50	30.45: 201	**Feynman Graph Polynomials** — •Christian Bogner
MP 9.1	Di	16:45–17:35	30.45: 201	**Spectral asymptotics of quantum percolation models** — •Peter Müller
MP 20.1	Do	14:00–14:50	30.45: 201	**Entangled?** — •Matthias Christandl

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SYQG 1.2	Mi	14:45–15:30	30.95: 001	**Does Quantum Gravity need Strings?** — •Constantin Bachas
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Fachsitzungen

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MP 3.1–3.2	Di	9:45–10:25	30.45: 201	**Noncommutative Spacetime**
MP 4.1–4.1	Di	11:00–11:45	30.95: 001	**Plenarvortrag I**
MP 5.1–5.1	Di	11:45–12:30	30.95: 001	**Plenarvortrag II**
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MP 15.1–15.1	Mi	20:00–21:00	30.21: 001	**Plenarvortrag V (Abendvortrag)**
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MP 17.1–17.2	Do	9:50–10:30	30.45: 201	**Quantum Information I**
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Mitgliederversammlung des Fachverbandes MP

Dienstag, 29.3.2011 18:30–19:30 Raum 30.45:201

- Bericht
- Wahl des Beirats
- Wahl des Leiters
- Verschiedenes

MP 1: Poster (permanent Tue-Thu)

Zeit: Dienstag 8:30–18:30 Raum: 30.45: 201

MP 1.1 Di 8:30 30.45: 201

Dynamics of spontaneous emission of light in the 2P→1S transition in hydrogen — •Piotr Marecki and Nikodem Szpak — Fakultät für Physik, Universität Duisburg-Essen

In the presentation we will report on the model of spontaneous emission which we have developed in 2005 [Annalen der Physik, 14, 428]. In the model a non-relativistic quantum system (an electron in a hydrogen atom) interacts via a linear term with the quantized radiation field. This model has no free parameters which could be adjusted. Recently we have finally reached a (surprisingly good) agreement between the predicted decay rate and the one observed in experiments for the 2P→1S decay in hydrogen in the presence of an initial vacuum state of the radiation field. For a long time, the predicted decay rate was too small and the mistake was finally found in the normalization of the quantum field (numerical factor standing in front of the Pauli-Jordan function). This again showed that the problem is one of the few precious examples where the structure of the theory allows for no room for adjustments and the agreement (on the level of few percent) is surprising (the electron is treated non-relativistically). In the poster, we will comment upon a large number of unnecessary problems present in the unusually obscure literature on the subject. In the end, the Laplace transform of the decay amplitude is shown (numerically) to possess only a single pole which dominates the dynamics (although the situation could have been much worse); corrections to the exponential law, albeit very small, come from the single cut in the complex plane.

MP 2: Classical Field Theory

Zeit: Dienstag 9:00–9:40 Raum: 30.45: 201

MP 2.1 Di 9:00 30.45: 201

Combinatorics of KP line solitons: a tropical approach — Folkert Müller-Hoissen[1] and •Aristophanes Dimakis[2] — [1]Max-Planck-Institute for Dynamics and Self-Organization, Bunsenstrasse 10, D-37073 Göttingen — [2]Department of Financial and Management Engineering, University of the Aegean, 41 Kountourioti Str., GR-82100 Chios

The Kadomtsev-Petviashvili (KP) equation in particular models certain network patterns formed by waves on shallow water in terms of line soliton solutions. The simplest class of such solutions corresponds, in a tropical approximation, to chains of rooted binary trees, and it turns out that they realize maximal chains in Tamari lattices (which are poset structures on associahedra). The analysis also makes contact with “higher-order” versions of Tamari lattices. A general line soliton network solution can be described, in good approximation, as a superimposition of solutions from the tree class, with rather simple modifications. All this yields a characterization of possible evolutions of wave network patterns on shallow water, provided that the KP approximation applies. It is based on our publication J. Phys. A: Math. Theor. 44 (2011) 025203.

MP 2.2 Di 9:20 30.45: 201

Fractal dynamics of ϕ^4 and ϕ^6 kinks. — •Yakov Shnir — Department of Physics, Carl von Ossietzky University Oldenburg

We discuss new results concerning chaotic dynamics in non-perturbative sectors of the classical one-dimensional ϕ^4 and ϕ^6 models. Considering the process of production of kink-antikink pairs in the collision of particle-like states we have shown that there are 3 steps in the process, the first step is to excite the oscillon intermediate state in the particle collision, the second step is a resonance excitation of the oscillon by the incoming perturbations, and finally, the soliton-antisoliton pair can be created from the resonantly excited oscillon. It is shown that the process depends fractally on the amplitude of the perturbations and the wave number of the perturbation. We also present the effective collective coordinate model for this process.

Considering the process of the kink-antikink collisions in the one-dimensional non-integrable scalar ϕ^6 model we reveal that, although the classical kink solutions for this model do not possess an internal vibrational model there is a resonant scattering structure of the process, thereby providing a counterexample to the common belief that existence of such a mode is a necessary condition for multi-bounce resonances in the kink-antikink collisions. We investigate the two-bounce windows in the velocity range and present evidence that this structure is entirely related to the spectrum of the bound states on the background of the combined kink-antikink configuration.

MP 3: Noncommutative Spacetime

Zeit: Dienstag 9:45–10:25 Raum: 30.45: 201

MP 3.1 Di 9:45 30.45: 201

The spectral action for Dirac operators with torsion — •Christoph Stephan, Florian Hanisch, and Frank Pfäffle — Institut für Mathematik, Universität Potsdam, Deutschland

We derive a formula for the gravitational part of the spectral action for Dirac operators on 4-dimensional manifolds with torsion. We find that the torsion becomes dynamical and we deduce the Lagrangian for the Standard Model of particle physics in presence of torsion from the Chamseddine-Connes Dirac operator.

MP 3.2 Di 10:05 30.45: 201

Wick Rotation on Noncommutative Space — •Thomas Ludwig[1], Harald Grosse[2], Gandalf Lechner[2], and Rainer Verch[3] — [1]Universität Leipzig & MPI MIS Leipzig — [2]Universität Wien — [3]Universität Leipzig

We consider Euclidean Moyal space with commutative time and investigate ways to get from a Euclidean field theory to a Minkowskian quantum field theory. Two main approaches are discussed: firstly, we start with a Euclidean net of C*-algebras satisfying the so-called time-zero condition and construct a Minkowskian net by analytically continuing the representation of the remaining Euclidean symmetries to a unitary representation of the corresponding Poincare subgroup. Secondly, we present results concerning the analytic continuation of noncommutative Schwinger functions.

MP 4: Plenarvortrag I

Zeit: Dienstag 11:00–11:45 Raum: 30.95: 001

Plenarvortrag MP 4.1 Di 11:00 30.95: 001
Flavour Physics in the LHC Era — •Andrzej Buras — Physik Department, Technische Universität München, James-Franck Str. 1 D-85748 Garching, Germany — TUM-Institute of Advanced Study

After a brief summary of the structure of the Standard Model of particle physics I will concentrate the presentation on the flavour and CP-violating interactions in this model and in the extensions of this model, that is in the so-called New Physics models. New Physics is required to solve a number of problems present in the Standard Model, in particular those related to the electroweak symmetry breaking and the hierarchies of quark and lepton masses and their flavour violating interactions. The violation of CP-symmetry and rare K and B decays as well as lepton flavour violation will play important roles in this talk. This decade should make a significant progress towards the Theory of Flavour and the main goal of this talk is to transfer this belief not only to my colleagues in the particle physics community but to the remaining members of the audience. Identification of particular patterns of flavour violation in the future data and the correlations between various observables, also those measured by the Large Hadron Collider at CERN, could help us to identify New Physics at very short distance scales and lead to a New Standard Model.

MP 5: Plenarvortrag II

Zeit: Dienstag 11:45–12:30 Raum: 30.95: 001

Plenarvortrag MP 5.1 Di 11:45 30.95: 001
Testing principles of General Relativity with an eye towards Quantum Gravity — •Domenico Giulini — Zentrum fuer angewandte Raumfahrttechnologie und Mikrogravitation (ZARM), Universität Bremen — Institut fuer Theoretische Physik, Leibniz Universität Hannover

The principles on which Quantum(Field)Theory and General Relativity rest are mutually incompatible. Various Quantum Gravity programs attempt to find a single consistent structure from which both previous ones can be retrieved in appropriate limits. Expectations diverge as to which of the old principles, if any, may survive this transition in some recognisable form. Here guidance from observations should be sought, though this is clearly highly demanding. I will discuss attempts and ideas to test some of the cherished principles of General Relativity, like in existing and proposed high precision quantum tests of the equivalence principle.

MP 6: Quantum Field Theory I

Zeit: Dienstag 14:00–14:50 Raum: 30.45: 201

Hauptvortrag MP 6.1 Di 14:00 30.45: 201
Feynman Graph Polynomials — •Christian Bogner — Institut für Theoretische Teilchenphysik und Kosmologie, RWTH Aachen

The integrand of any multi-loop integral in its Feynman parametric form is characterized by the first and the second Symanzik polynomial. These graph polynomials play a crucial role in current techniques for the computation of Feynman integrals as well as in recent formal researches related to periods in geometry. In this talk I review combinatorial properties of these polynomials, including their construction from spanning forests and from determinants of Laplacian matrices, their behaviour under the deletion/contraction of edges and Dodgson-type factorization identities. I furthermore discuss a certain application of matroid theory to the subject of Feynman integrals.

MP 7: Quantum Field Theory II

Zeit: Dienstag 14:55–15:55 Raum: 30.45: 201

MP 7.1 Di 14:55 30.45: 201
The BV formalism applied to classical gravity — •Katarzyna Rejzner — 2. Institut für Theoretische Physik, Hamburg, Deutschland

I will give an interpretation of the BV operator which is based on infinite dimensional differential geometry. Using this mathematically precise formulation one can apply the BV method in the functional approach to classical and quantum field theory. As an example I will discuss general relativity in the framework of locally covariant field theory.

MP 7.2 Di 15:15 30.45: 201
Defektformierung in der Quantenfeldtheorie — Jürgen Berges und •Stefan Roth — TU Darmstadt, Deutschland

Abstract: We propose a quantum approach to nonequilibrium dynamics which combines the successful aspects of classical-statistical simulations on a lattice with the ability to take into account quantum corrections. It is based on the 2PI effective action for inhomogeneous fields and a volume average. This procedure does not involve any double counting which could appear in sampling prescriptions for inhomogeneous quantum evolutions. As an example, we study nonequilibrium dynamics of defect formation in $1+1$ dimensional relativistic scalar field theory and compare to insufficient descriptions based on homogeneous quantum fields. (arXiv:hep-ph/1012.1212)

MP 7.3 Di 15:35 30.45: 201
Renormalization with Flow Equations and the ABJ anomaly — •Benjamin Leveque and Christoph Kopper — Centre de Physique theorique, Ecole Polytechnique

We study the renormalizability of axial abelian gauge theory within the flow equation framework in which the theory is regularized in a way which does not respect gauge-invariance but permits to rigorously apply Euclidean path integral methods.

On the one hand we prove renormalizability in the weak sense of power counting; on the other hand we analyse the Slavnov- Taylor-identities of the theory to show that these cannot be restored after taking away the regulators as has been proven in the case of non-anomalous theories like QED. We insist on the relation between the anomaly and the infrared problem for theories with massless particles. We have no evidence that the anomaly is related to the transformation properties of the integration measure in the path integral as is sometimes asserted in the literature but rather to the properties of triangular diagramme analysed by Adler and followers.

MP 8: Quantum Mechanics and Many Particle Systems I

Zeit: Dienstag 15:55–16:15 Raum: 30.45: 201

MP 8.1 Di 15:55 30.45: 201

Strong-field-QED effects in an optical lattice — •Nikodem Szpak — Fakultät für Physik, Universität Duisburg-Essen

We present a model describing cold atoms in an optical lattice which shows phenomena known from the strong field QED (spontaneous pair creation, Schwinger effect). The main advantage of that analogue system is experimental accessibility of the strong field regime in contrast to the real QED. Formulation of the model requires a new derivation of an effective Fermi-Hubbard Hamiltonian from first principles of the (many-body) quantum field theory. We shall present main steps of the derivation followed by examples of the analogue QED effects appearing on the lattice obtained by analytical and numerical methods.

MP 9: Quantum Statistics

Zeit: Dienstag 16:45–17:35 Raum: 30.45: 201

Hauptvortrag MP 9.1 Di 16:45 30.45: 201

Spectral asymptotics of quantum percolation models — •Peter Müller — Mathematisches Institut, Universität München, Theresienstr. 39, 80333 München, Germany

In recent years there has been quite some activity and progress concerning spectral asymptotics of Laplace-type operators that are defined on percolation subgraphs of a given graph. In this survey talk I shall review some of these results and explain the necessary background. Among others, I shall be concerned with the equality of Lifshits and van Hove exponents of the integrated density of states.

MP 10: Quantum Mechanics and Many Particle Systems II

Zeit: Dienstag 17:40–18:20 Raum: 30.45: 201

MP 10.1 Di 17:40 30.45: 201

Kritische Kopplungskonstante des zweidimensionalen No-Pair-Weyloperators mit homogenem Magnetfeld und Coulombsingularität — •Thomas Maier und Heinz Siedentop — Mathematisches Institut, Ludwig-Maximilians-Universität München, Theresienstraße 39, DE-80333 München

Wir zeigen, dass die kritische Kopplungskonstante des zweidimensionalen No-Pair-Weyloperators mit homogenem Magnetfeld und Coulombsingularität gleich der des zweidimensionalen No-Pair-Weyloperators mit Coulombsingularität ohne magnetischem Feld ist.

Wir transformieren den Weyloperator in die Darstellung, in der die kinetische Energie diagonal ist und schätzen das Coulombpotential in dieser Darstellung mittels eines auf Schur zurückgehenden Argumentes durch einen Multiplikationsoperator nach unten ab. Die sich daraus ergebende Schranke an die Kopplungskonstante ist scharf.

Dieses Resultat liefert einen Beitrag zur mathematischen Beschreibung von Graphen.

MP 10.2 Di 18:00 30.45: 201

Die kritische Kernladung eines Fremdatoms in Graphene im homogenen Magnetfeld — Thomas Maier und •Heinz Siedentop — Mathematisches Institut, Ludwig-Maximilians-Universität München, Theresienstr. 39, 80333 München

Wir zeigen, daß die kritische Kernladungszahl eines Atoms auf Graphen, bis zu der die Energie nach unten beschränkt bleibt, durch ein konstantes Magnetfeld nicht verändert wird.

MP 11: Quantum Field Theory in Curved Spacetime

Zeit: Mittwoch 8:30–9:50 Raum: 30.45: 201

MP 11.1 Mi 8:30 30.45: 201

Local thermal equilibrium for quantum fields on cosmological spacetimes — •Michael Gransee[1,2], Alexander Knospe[2], and Rainer Verch[2] — [1]MPI Mathematics in the Sciences, Leipzig — [2]Universität Leipzig

We investigate the consistency of local thermal equilibrium for scalar and Dirac fields on cosmological spacetimes with respect to general covariance and the Hadamard renormalization prescription for the stress-energy tensor. The renormalized stress-energy tensor fulfilling the local thermal equilibrium condition has a thermal part, a dynamical part and a purely geometrical part. The latter contains the renormalization freedom. Since the thermal part differs from the total stress-energy, one finds a temperature dependence on cosmological time which has a stronger singularity in the limit of early cosmological times than in the classical treatment of radiation.

MP 11.2 Mi 8:50 30.45: 201

Quantization of the Electromagnetic Potential in Asymptotically Flat Spacetimes — •Daniel Siemssen — II. Institut für theoretische Physik der Universität Hamburg, Hamburg, Deutschland

In quantum field theory on curved spacetimes there exists, in general, no preferred choice of a vacuum state. Using a holographic approach it has been shown that one can construct a distinguished Hadamard state for the free scalar field in asymptotically flat spacetimes. Applying the same methods, I will discuss how to construct a BMS invariant state for the electromagnetic potential on past null infinity of an asymptotically flat spacetime and how the pull-back to the bulk yields a Hadamard state.

MP 11.3 Mi 9:10 30.45: 201

Quantum Pressure Inequalities — •Jan Zschoche[1,2] and Rainer Verch[2] — [1]MPI-MIS, Leipzig, Germany — [2]Univ. Leipzig, Leipzig, Germany

It is known that pointwise energy inequalities are violated in quantum field theory. Such inequalities restrict the magnitude of pressure (also negative pressure) with respect to the energy density. We modify the known quantum energy inequalities, which provide state-independent lower bounds on space-time averages of the energy density, to obtain a priori bounds on space-time averages of pressure for quantum fields on curved space-time.

MP 11.4 Mi 9:30 30.45: 201

Physics in vortex spacetimes: from the core to infinity — •Piotr Marecki — Uni Duisburg-Essen

In the talk I will continue to develop the subject already reported upon in the 2010 DPG Frühjahrstagung, namely the study of physical and mathematical problems related to the behavior of (classical and quantum) fields in “rotating spacetimes”. The discussion is based upon an analogy between scalar fields in curved spacetimes and sound-waves propagating on irrotational background flows of fluids. As discussed in 2010 a typical superfluid vortex provides a good arena to study some of the most important issues expected to arise. (Essential points will be repeated in the introduction.) In this talk I will focus on the relation between sound scattering on a vortex and the Bohm-Aharonov scattering, and also on the issue of extending the "radial operator" to the core of the vortex. In the latter case I will make contact with the standard theory of extensions of non-essentially-selfadjoint operators (for singular potentials), and discuss how the parameter specifying the chosen extension influences scattering characteristics.

MP 12: Plenarvortrag III (Preisträgervortrag)

Zeit: Mittwoch 11:30–12:00 Raum: 30.95: 001

Preisträgervortrag MP 12.1 Mi 11:30 30.95: 001
Diffraktion bei der Streuung hochenergetischer und stark virtueller Photonen an Protonen bei HERA — •Günter Wolf — DESY, Hamburg

Am Elektron-Proton Speicherring HERA bei DESY wurde Diffraktion bis zu hohen Schwerpunkstenergien, $W = 20 - 250\,\text{GeV}$, und Photon-Virtualitäten, $Q^2 = 0 - 1600\,\text{GeV}^2$, untersucht. Bei $W = 200\,\text{GeV}$ und $Q^2 = 4\,\text{GeV}^2$ beträgt der Beitrag zum totalen Photon-Proton Wirkungsquerschnitt 15% und immer noch 4% bei $Q^2 = 200\,\text{GeV}^2$. Die Ergebnisse der H1 und ZEUS Experimente und ein Ausblick auf Diffraktion bei LHC werden präsentiert.

MP 13: Plenarvortrag IV

Zeit: Mittwoch 12:00–12:45 Raum: 30.95: 001

Plenarvortrag MP 13.1 Mi 12:00 30.95: 001
Der Large Hadron Collider LHC: Beginn einer neuen Ära in der Wissenschaft — •Rolf Heuer — CERN, Genf, Schweiz

Mit dem Start des Large Hadron Collider (LHC) am CERN beginnt eine neue Ära der Teilchenphysik. Der LHC wird ein tieferes Verständnis von den Vorgängen im Universum liefern und hat das Potenzial, unser Weltbild zu revolutionieren. Wir erwarten tiefgreifende Erkenntnisse über den Aufbau und Ursprung der Materie, der Natur der Dunklen Materie und vielleicht über die Existenz zusätzlicher Raumdimensionen. Mein Vortrag wird das faszinierende Physikpotenzial des LHC beschreiben, die wichtigsten Ergebnisse von der ersten Datennahme im vergangenen Jahr vorstellen und einen Ausblick auf die Elementarteilchenphysik an der Hochenergiefront liefern.

MP 14: Quantengravitation und Quantengravitationsphänomenologie (gemeinsam mit GR)

Zeit: Mittwoch 16:45–19:00 Raum: 30.45: 101

Hauptvortrag MP 14.1 Mi 16:45 30.45: 101
Loop quantum gravity — •Carlo Rovelli — Centre de Physique Thèorique, Université de Aix-Marseille, France

I give a general overview of the state of loop quantum gravity, focusing on its covariant version, and of the main results the theory.

Hauptvortrag MP 14.2 Mi 17:30 30.45: 101
Causal Dynamical Triangulation - A Gateway to Quantum Gravity — •Renate Loll[1], Jan Ambjorn[2], and Jerzy Jurkiewicz[3] — [1]Institute for Theoretical Physics, Utrecht University, Utrecht, The Netherlands — [2]Niels Bohr Institute, Copenhagen University, Copenhagen, Denmark — [3]Jagiellonian University, Krakow, Poland

The nonperturbative theory of Quantum Gravity constructed using the method of Causal Dynamical Triangulation (CDT) has made considerable progress in explaining the macroscopic structure of spacetime from first (quantum) principles. This includes the "postdictions" that spacetime on large scales is four-dimensional and - in the absence of matter - looks like a de Sitter universe. By contrast, near the Planck scale, spacetime behaves highly non-classically and exhibits two-dimensional features, for which corroborating evidence has meanwhile been found in several other approaches. After summarizing the rationale behind CDT and its main achievements, I will highlight some new results and insights, including CDT's phase structure, which may provide a blueprint for models of dynamical, higher-dimensional geometry, as well as short- and large-scale geometric properties of the dynamically generated quantum universe and their potential implications for quantum cosmology.

Hauptvortrag MP 14.3 Mi 18:15 30.45: 101
Geometry and Observables in three-dimensional (Quantum) Gravity — •Catherine Meusburger — Fachbereich Mathematik, Bereich AZ, Universität Hamburg, Bundesstraße 55, 20146 Hamburg

Three-dimensionsional gravity serves as a model in which fundamental questions of quantum gravity can be investigated in a fully and rigorously quantised theory. A central question for its interpretation is the relation between the fundamental diffeomorphism invariant observables of the theory and the geometry of the spacetimes. We show how these observables can be related to concrete measurements by observers in terms of lightrays. These measurements allow the observer to fully determine the geometry of the spacetime in finite eigentime.

MP 15: Plenarvortrag V (Abendvortrag)

Zeit: Mittwoch 20:00–21:00 Raum: 30.21: 001

Abendvortrag MP 15.1 Mi 20:00 30.21: 001
Von den höchsten Energien zu den kleinsten Teilchen: dem Urknall auf der Spur — •Thomas Müller — Institut für Experimentelle Kernphysik, Karlsruher Institut fuer Technologie KIT

Die vielleicht wichtigste Frage der Wissenschaft lautet: woraus besteht das Universum, und wie ist es entstanden? Die moderne Elementarteilchenphysik beschäftigt sich mit der Suche nach den kleinsten Bausteinen der Natur und den Kräften, mit denen sie wechselwirken. Auch sucht sie nach einer Erklärung der Frage, warum die uns vertraute Materie nur etwa fünf Prozent der gesamten Masse des Universums ausmacht und woraus der Rest besteht. Zu diesem Zweck werden im Labor Zustände bei höchsten Energien und Teilchendichten, wie sie im frühesten Universum stattgefunden haben, nachgestellt. Der letztes Jahr am CERN bei Genf in Betrieb genommene Large Hadron Collider, das größte von Menschenhand gebaute Instrument, erlaubt uns, weit in dieses Neuland höchster Energien vorzustoßen. In meinem Vortrag stelle ich erste Resultate und das Entdeckungspotential dieses faszinierenden Projektes vor.

MP 16: Quantum Field Theory in 2 Dimensions

Zeit: Donnerstag 8:30–9:50 Raum: 30.45: 201

MP 16.1 Do 8:30 30.45: 201

Symmetries and discretizations of the O(3) nonlinear sigma model — •Raphael Flore — TPI, Universität Jena, Deutschland

Nonlinear sigma models possess many interesting properties like asymptotic freedom, confinement or dynamical mass generation, and hence serve as toy models for QCD and other theories. We derive a formulation of the N=2 supersymmetric extension of the O(3) nonlinear sigma model in terms of constrained field variables. Starting from this formulation, it is discussed how the model can be discretized in a way that maintains as many symmetries of the theory as possible. Finally, recent numerical results related to these discretizations are presented.

MP 16.2 Do 8:50 30.45: 201

Particle aspects of two-dimensional conformal field theories — •Wojciech Dybalski[1] and Yoh Tanimoto[2] — [1]Zentrum Mathematik, Technische Universität München, D-85747 Garching, Germany — [2]Dipartimento di Matematica, Universita di Roma "Tor Vergata", Via della Ricerca Scientifica 1, I-00133 Roma, Italy

Particle aspects of two-dimensional conformal field theories are investigated, using methods from algebraic quantum field theory. The results include asymptotic completeness in terms of (counterparts of) Wigner particles in any vacuum sector and the existence of (counterparts of) infraparticles in any charged sector of a given chiral conformal field theory. Moreover, an interesting interplay between infraparticle's momentum and the superselection structure is demonstrated in a large class of examples. This phenomenon resembles electron's momentum superselection in quantum electrodynamics.

MP 16.3 Do 9:10 30.45: 201

Local Commutators and Deformations in Conformal Chiral Quantum Field Theories — •Antonia Kukhtina — Institut für theoretische Physik, Universität Göttingen

We study the general form of Möbius covariant commutation relations in conformal chiral quantum field theories and show that they are intrinsically determined up to structure constants, which are subject to an infinite set of constraints. The deformation theory of these commutators is controlled by a cohomology complex, whose cochain spaces are built up out of functions that are subject to a more complicated symmetry property, a generalization of the anti-symmetry of the Lie algebra case.

MP 16.4 Do 9:30 30.45: 201

Construction of Models in Boundary Quantum Field Theory — •Marcel Bischoff — Department of Mathematics, University of Rome "Tor Vergata", Italy

One approach to quantum field theory is the study of nets of von Neumann algebras on a given space-time. In this operator algebraic approach lately a new construction of local and time-translation (but in general not conformal) covariant nets on Minkowski half-plane was given by Longo and Witten by taking as input a chiral conformal net and an element of a semi-group associated to the net. The elements of this abstractly defined semi-group can be seen as deformations of the trivial (conformal) boundary net.

We investigate the construction of non-trivial elements for a family of chiral nets, which therefore give rise to further boundary quantum field theory models.

MP 17: Quantum Information I

Zeit: Donnerstag 9:50–10:30 Raum: 30.45: 201

MP 17.1 Do 9:50 30.45: 201

Quantum fluctuators and the tensor algebra method — •Zoltan Zimboras, Michael Keyl, Zoltan Kadar, and Dirk-Michael Schlingemann — Quantum Information Group, ISI, Torino, Italy

Quantum fluctuators appear in physics in many different contexts, e.g., quantum phase transitions, finite size corrections to mean-field theories, non-commutative central limit theorems. Recently they have also been applied in quantum information theory in the description of quantum memories. In the above fields the way how the thermodynamic limit is taken differs from one another, which results in different definitions for the limiting fluctuators. In this talk we would like to show how the tensor algebra method (borrowed from constructive field theory) provides a natural unified description of all these limits. Furthermore, it is a flexible formalism for attacking existing problems from a different point of view, as will be demonstrated by examples of quantum information theory. (arXiv:1006.3461)

MP 17.2 Do 10:10 30.45: 201

Quantum fluctuators for simulating continuous quantum systems by discrete ones. — •Zoltan Kadar, Michael Keyl, and Zoltan Zimboras — Quantum Information Group, ISI, Torino, Italy

Classical simulation of quantum many-body systems is usually very inefficient with long running times and high needs for memory (e.g., it is not even possible to store classically the arbitrary state of 50 qubits). One might overcome these difficulties by using other quantum systems, similar to the one we want to study, as quantum simulators. Most of the efforts in this direction has been concentrated on simulating discrete quantum systems (e.g. spin chains) with other ones that are relatively easy to prepare in the lab (ion traps, atoms in optical lattices, etc.). In this talk, I will treat a different problem: How can we simulate a continuous quantum system (e.g. a QFT) with a discrete one? In particular, I will show how (and in which sense) one can use the global quantum fluctuator observables of a discrete lattice system to store continuous quantum information. Finally, the question of how the stored state of a light field can be processed by operations on the discrete system is considered.

MP 18: Plenarvortrag VI

Zeit: Donnerstag 11:00–11:45 Raum: 30.95: 001

Plenarvortrag MP 18.1 Do 11:00 30.95: 001

Quantum Field Theory on curved backgrounds and its impact on cosmology — •Klaus Fredenhagen — II. Institut für Theoretische Physik, Hamburg

The general structure of quantum field theory on curved backgrounds is nowadays well understood on the basis of the principle of local covariance and the microlocal spectrum condition. It requires, however, to give up the traditional interpretation of quantum field theory in terms of particle scattering. If applied to cosmology, the interpretation of observations in terms of classical matter turns out to be unsufficient and has to be replaced by an interpretation in terms of locally covariant quantum fields whose definition involve a few free parameters which are independent of the spacetime structure and the quantum state.

These concepts were applied to the semiclassical Einstein equation for a free quantum field. An evaluation of this equation in a suitable state provides a time evolution of the scale parameter of the Friedmann universe which is in perfect agreement with recent cosmological data and provides a natural explanation of dark energy and dark matter.

MP 19: Plenarvortrag VII

Zeit: Donnerstag 11:45–12:30 Raum: 30.95: 001

Plenarvortrag MP 19.1 Do 11:45 30.95: 001
Recent Progress in Direct Searches for WIMP Dark Matter — •Uwe Oberlack — Institut für Physik, Johannes Gutenberg Universität Mainz

85% of the matter in the universe consists of non-baryonic cold Dark Matter. We observe its gravitational influence in large astrophysical systems ranging from galaxies to galaxy clusters, and on the scale of the universe as a whole. Dark Matter is the driving force for structure formation and dominated the evolution of the universe over most of its history. Dark Matter, together with Dark Energy, is arguably our most solid evidence for physics beyond the Standard Model of particles and fields. Yet, we do not understand the nature of Dark Matter.

Weakly Interacting Massive Particles (WIMPs), a thermal relic of the hot Big Bang, make up a generic class of well-motivated Dark Matter candidates. Direct Dark Matter searches seek to detect WIMPs through their scattering with atomic nuclei. German research groups play an important role in this pursuit. This talk will review the current status and recent progress of the field, and look forward to the next steps of ton-scale detectors.

MP 20: Quantum Information II

Zeit: Donnerstag 14:00–14:50 Raum: 30.45: 201

Hauptvortrag MP 20.1 Do 14:00 30.45: 201
Entangled? — •Matthias Christandl — ETH Zurich

A quantum state is entangled if it cannot be described by classical correlations alone. Entangled states are responsible for the security of quantum cryptography, the speed-up in quantum computation and properties of many physical systems. But if an experimenter has determined the quantum state of his system, how can he find out whether or not the state is in fact entangled? Answering this question has kept the field of quantum information theory busy since its beginning. After an introduction to the subject, I will explain the fastest way of determining when a state is entangled, a result recently obtained in joint work with Fernando Brandao and Jon Yard.

MP 21: Quantum Information III

Zeit: Donnerstag 14:55–15:55 Raum: 30.45: 201

MP 21.1 Do 14:55 30.45: 201
Quantum Systems Theory and Applications to Quantum Simulation under Collective Controls – an Invitation — •Thomas Schulte-Herbrüggen and Robert Zeier — Dept. Chem., TU-Munich, Germany

We present a unified framework of Lie-algebraic quantum systems theory. It provides a powerful yet straight-forward access to settle problems of controllability, observability, and the design of universal quantum hardware.

A particular focus is on the symmetry principles of quantum simulation. They govern under which conditions and to which extent spin systems, fermionic systems, and bosonic systems can mutually simulate oneanother. Finally, we give an explorative outline of quantum dynamics under collective Hamiltonian controls meant to invite further research.

MP 21.2 Do 15:15 30.45: 201
Geometry of Markovian Quantum Channels Seen as Lie Semigroups — •Corey O'Meara[1], Gunther Dirr[2], and Thomas Schulte-Herbrüggen[1] — [1]Dept. Chem. TU-Munich, Germany — [2]Math. Inst., University of Würzburg, Germany

A plethora of Markovian quantum channels under various degrees of Hamiltonian control are analysed in terms of their differential geometric properties. To this end, the set of all Markovian CP maps described as the solutions of a controlled Kossakowski-Lindblad master equation are characterized as Lie (sub)semigroups. Thus, for depolarising, dephasing, amplitude damping, bit-flip, or phase-flip channels we focus on the specific structure of their Lie wedges being suitable tangent cones encapsulating the control directions as their edge.

Since the geometry of the Lie wedge completely determines the time evolution underlying the controlled quantum channel, this most illustrative insight may subsequently be exploited to approximate the reachable sets of given initial quantum states. Finally, possible applications are outlined.

MP 21.3 Do 15:35 30.45: 201
Limits on non-local correlations from the structure of the local state space — •Peter Janotta[1], Christian Gogolin[2,3], Jonathan Barrett[4,5], and Nicolas Brunner[5] — [1]Fakultät für Physik und Astronomie, Universität Würzburg, Germany — [2]Institute for Physics and Astronomy, Potsdam University, Germany — [3]Department of Mathematics, University of Bristol, U.K. — [4]Department of Mathematics, Royal Holloway, University of London, U.K. — [5]H.H. Wills Physics Laboratory, University of Bristol, U.K.

Nonlocality is arguably one of the most remarkable features of quantum mechanics. On the other hand nature seems to forbid other no-signaling correlations that cannot be generated by quantum systems. Usual approaches to explain this limitation are based on information theoretic properties of the correlations without any reference to physical theories they might emerge from.

In contrast to that we investigate a transition between bipartite classical, no-signaling and quantum correlations by considering generalized probabilistic theories. It turns out that the strength of nonlocality of the maximally entangled state depends crucially on a simple geometric property of the local state space, known as strong self-duality. In particular strong self-duality implies macroscopic locality and therefore Tsirelson's bound for correlations of the maximally entangled state in quantum mechanics. Finally, our results also show that there exist models which are locally almost indistinguishable from quantum mechanics, but can nevertheless generate maximally nonlocal correlations.

MP 22: Various

Zeit: Donnerstag 16:15–17:15 Raum: 30.45: 201

MP 22.1 Do 16:15 30.45: 201
Wie hilfreich ist die Wissenschaftstheorie? — •Helmut Hille — Fritz-Haber-Straße 34, 74081 Heilbronn

Der Fehler der meisten Philosophen ist, dass sie den Menschen als ein abstraktes Wesen ohne Lebensbezug behandeln. Der Fehler der Wissenschaftstheoretiker und der Vertreter von Erkenntnistheorien ist, dass sie ihre Aussagen aus und mit der Forschung selber begründen wollen und wegen der Ausblendung der Beobachterrolle daher notwendig zu unkritisch sind. Es sollen Wege aufgezeigt werden, die zu einem abgeklärten Standpunkt führen, von dem aus theoretische Aussagen geprüft werden können. Nur so kann eine Intersubjektivität entstehen, d.h. "die Stufe objektiver Gültigkeit erstrebender Wissenschaft", die auf Einsichten und nicht auf Einigungen beruht. Weder kann Weisheit ohne Wissen, noch Wissen ohne Weisheit gelingen kann, weshalb es darauf ankommt, Naturwissenschaft und Philosophie ohne gegenseitigen Vereinnahmungsversuche im Dialog zusammenzuführen.

MP 22.2 Do 16:35 30.45: 201

Mathematical Physics — •Arno Gorgels[1] and Shevkinaz Bulut[2] — [1]Hans-Thoma-Straße 3, 14467 Potsdam — [2]Etzelstraße 224, 50739 Köln

Mathematical descriptions such as Lorentz-transformations or the mathematical formulation of quantum mechanics are often taken as "mathematical physics". In this paper, a mathematical theory of nature is only called "Mathematical Physics" when its mathematical axioms are identifiable in nature. The authors believe - based upon an idea of the mathematician Amir D. Aczel - that Set Theory complies with this requirement.

The physical continuum, limited to 10 levels of Cantor's mathematical continuum, allows, in addition to electrons and positrons, the occurrence of electrically charged particles with +2/3e and -1/3e. These newly-postulated particles now allow us to define the internal structure of protons and neutrons as follows. The new elementary particles are called eon (-1/3e) and peon (+2/3e).

1- Proton = ê + Peon + 2.Eon 2- Neutron = p + e 3- Up Quark = ê + Peon + e 4- Down Quark = ê + Eon + e

The interaction of positron, eon, peon, and electron are measured as proton, neutron, up-Quark and down-Quark. The elements positron, peon and eon may be experimental results of the current hadron colliding experiments in CERN.

Further theoretical study linked with experimental investigations should provide the necessary evidence to consolidate this approach.

MP 22.3 Do 16:55 30.45: 201

Die Strukturen der Planck-Resonatoren im Raum der Hintergrundstrahlung und ihr Zusammenhang mit dem totalen Energiesystem — •Erhard Schulz — Wiesenstr. 32, 01987 Schwarzheide

Basis dieser Arbeit ist eine quantisierte Beschreibung der Totalenergie eines freien Teilchens, also eines Planckresonators. Dieser hat immer eine relativistische Form mit folgender Darstellung: E = h(f(Licht) + f(Rotation))= hf = reales Photon, mit f(Licht) = 0,1,2,[Hz]= Lichtfrequenz = reines Photon, f(Rotation) = 0,1,2,[Hz]= Rotationsfrequenz = reines Roton. Alle physikalischen Größen (Impuls = p, Drehimpuls, Masse, Geschwindigkeit,) werden mit der Photon-Frequenz = f, f(Licht), f(Rotation),h = Planckkonstante und c = Lichtgeschwindigkeit dargestellt. Ein reiner Zustand kann nicht gemessen werden, deshalb trägt ein reales Photon immer einen Impuls und einen Drehimpuls. Bei einer konstanten Totalenergie ist die Summe der Komponenten konstant, aber die Komponenten können innerhalb der Summe variieren. Dadurch ändert sich die Entropie, wenn der Resonator schwingt. Diese Tatsache führt zu einer neuen Darstellung des thermodynamischen Gleichgewichts. Die quantisierte Form der Totalenergie beweist, dass die physikalische Zeit und die Kraft mit einer Änderung der Photonen-Rotonenzahl im System verbunden sind. In diesem Zustand bilden die reinen Rotonen den Potenzialkasten, der die reinen Photonen bindet. Das Planckgesetz ist der experimentelle Beweis für die Aussagen der speziellen Relativitätstheorie, wenn obige Definition der quantisierten Totalenergie benutzt wird.