Fachverband Theoretische und Mathematische Grundlagen der Physik (MP)

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Übersicht der Hauptvorträge und Fachsitzungen

(alle Sitzungen des FV MP im Hörsaal JUR H)

Hauptvorträge

MP 3.1	Di	14:00–14:50	JUR H	**Local thermal equilibrium and gravity** — •Rainer Verch
MP 7.1	Mi	14:00–14:50	JUR H	**Bulk universality for Wigner random matrices** — •Benjamin Schlein
MP 12.1	Do	14:00–14:50	JUR H	**Conformal field theory with boundaries** — •Ingo Runkel

Gemeinsames Symposium "Black Holes"

mit FV Gravitation, FV Extraterrestrik, FV Teilchen, FV Hadronen und Kerne, AG Phil und Astronomische Gesellschaft

SYBH 1.1	Mo	13:15–13:50	HG Aula	**From the Geometry of Spacetime to the Geometry of Numbers** — •Stefan Hollands
SYBH 1.2	Mo	13:50–14:25	HG Aula	**Black Holes in Four and Higher Dimensions** — •Jutta Kunz
SYBH 1.3	Mo	14:25–15:00	HG Aula	**Philosophical Aspects of Black Holes** — •Chris Smeenk
SYBH 1.4	Mo	15:20–15:55	HG Aula	**Super-Massive Black Holes at the Centers of Galaxies: The Case of Sagittarius A* at the Center of the Milky Way** — •Andreas Eckart
SYBH 1.5	Mo	15:55–16:30	HG Aula	**Classical and Relativistic Dynamics of Supermassive Black Holes and their Spin in Galactic Nuclei** — •Rainer Spurzem

Fachsitzungen MP

MP 1.1–1.2	Di	8:30– 9:20	JUR H	**Quantum Mechanics**
MP 2.1–2.2	Di	9:30–10:20	JUR H	**Noncommutative Geometry**
MP 3.1–3.1	Di	14:00–14:50	JUR H	**Hauptvortrag**
MP 4.1–4.3	Di	15:00–16:15	JUR H	**Quantum Field Theory on Curved Spacetime**
MP 5.1–5.3	Di	16:45–18:00	JUR H	**Quantum Information**
MP 6.1–6.3	Mi	8:30– 9:45	JUR H	**Quantum Field Theory**
MP 7.1–7.1	Mi	14:00–14:50	JUR H	**Hauptvortrag**
MP 8.1–8.3	Mi	15:00–16:15	JUR H	**Quantum Mechanics**
MP 9.1–9.3	Mi	16:45–18:00	JUR H	**Quantum Field Theory**
MP 10.1–10.2	Do	8:30– 9:20	JUR H	**Noncommutative Geometry**
MP 11.1–11.2	Do	9:30–10:20	JUR H	**Noncommutative Geometry**
MP 12.1–12.1	Do	14:00–14:50	JUR H	**Hauptvortrag**
MP 13.1–13.3	Do	15:00–16:15	JUR H	**Quantum Field Theory**

Mitgliederversammlung des FV Theoretische und Mathematische Grundlagen der Physik

(Gäste sind willkommen)

Mittwoch 18:15–19:00 JUR H

- Feststellung der Tagesordnung und Genehmigung des Protokolls der letzten MV vom 10.3.2009
- Bericht
- Zukünftige Tagungen des FV
- Verschiedenes

MP 1: Quantum Mechanics

Zeit: Dienstag 8:30–9:20 Raum: JUR H

MP 1.1 Di 8:30 JUR H

Linear phase-space representations of quantum mechanics with minimal uncertainty in position — •Edmund Menge[1] and Hajo Leschke[2] — [1]Uni Mainz — [2]Uni Erlangen

Quantum mechanics with a non-zero uncertainty in position can be generated by a one-parameter generalisation of the canonical commutation relation of ordinary quantum mechanics. This generalisation may be, for example, used in "Quantum Loop Gravity". For such a quantum mechanics with non-zero uncertainty in position a class of linear phase-space representations is defined, covering the well known phase space representation of Weyl, Wigner and Moyal as a limiting case. Applying the Lie-Trotter formula, these representations lead to a transcription of the new Schrödinger-Semigroup as a sequence of finite-dimensional integrals. These integrals can be informally be interpreted as a phase-space path integral.

MP 1.2 Di 8:55 JUR H

Lower bounds for atomic ground state energies via the Feynman-Kac formula — •Hans Konrad Knörr[1] and Hajo Leschke[2] — [1]Universität Mainz, Germany — [2]Universität Erlangen, Germany

We consider a system of an atomic nucleus and electrons which are coupled by a pure Coulomb interaction. The ground state energy of this system can be calculated as a low temperature limit of a term that is written as a (conditioned) Wiener integral via the Feynman-Kac formula. Using this as a starting point we follow an idea of A. Debiard and B. Gaveau (Math. Phys. An. Geom. 3, 91-100 (2000)) to derive a lower bound to the energy spectrum. The supremum of the integrand of the Wiener intergral can be estimated by applying some methods from Stochastic Analysis, e.g. the Birkhoff-Chintchine ergodic theorem. The obtained lower bound to the ground state energy is very precise for small electron numbers.

MP 2: Noncommutative Geometry

Zeit: Dienstag 9:30–10:20 Raum: JUR H

MP 2.1 Di 9:30 JUR H

Spectral distance on the Moyal plane — •Pierre Martinetti — Universität Göttingen and Courant Centre

We compute the spectral distance, defined in Connes' Noncommutative Geometry, in the Moyal plane. We find that the distance between the eigenstates $m, m+1$ of the quantum harmonic oscillator is proportional to $m^{-1/2}$. We also show how to truncate the Moyal spectral triple in order to obtain quantum metric spaces in the sense of Rieffel.

MP 2.2 Di 9:55 JUR H

Conjugate variables in quantum field theory: the conformal case — •Burkhard Eden and Klaus Sibold — Universität Leipzig, Institut für theoretische Physik, Vor dem Hospitaltore 1, 04103 Leipzig, Deutschland

Within standard quantum field theory of one scalar field we devise a scheme of constructing operators conjugate to the energy-momentum operators of the theory. We require them to arise from local operators, to represent charges, to transform as a vector under Lorentz transformations and to have dimension -1. These specifications single out the charges generating special conformal transformations. We solve all relevant eigenvalue problems, relate them to each other and reconstruct ordinary Fock space in terms of the eigenstates. We have a look at Pauli's theorem, point out applications of these conjugate operators and discuss the extension of the construction to other models.

MP 3: Hauptvortrag

Zeit: Dienstag 14:00–14:50 Raum: JUR H

Hauptvortrag MP 3.1 Di 14:00 JUR H

Local thermal equilibrium and gravity — •Rainer Verch — Institut für Theoretische Physik, Universität Leipzig

In cosmology, many assertions are based on assuming that matter is close to thermal equilibrium. Detlev Buchholz et al. have made an attempt towards a more precise concept of local thermal equilibrium in quantum field theory. We present an approach towards generalization of this concept to quantum field theory in curved spacetimes, and some interesting results, also pertaining to scenarios in cosmology.

MP 4: Quantum Field Theory on Curved Spacetime

Zeit: Dienstag 15:00–16:15 Raum: JUR H

MP 4.1 Di 15:00 JUR H

QFT in stationary, axisymmetric spacetimes: lessons from vortex models — •Piotr Marecki — Universität Leipzig, Leipzig, Deutschland

Constructions of QFT of scalar fields in (stationary) spacetimes with ergospheres usually encounter peculiarities, most of which can be traced to the non-positivity of the classical energy functional. Not only are these difficulties of constructive nature, but they are known to be related to deep physical phenomena, which are speculated to take place in such spacetimes (ergosphere instabilities, Klein-paradox instabilities). We shall report on results, related to the above issues, achieved in the context of "spacetimes" taken from the analog-gravity correspondence ("acoustic spacetimes"). A spacetime of an acoustic irrotational vortex (stable, abundant configurations of rotating superfluids) provides an arena, where (in our opinion) the aforementioned QFT problems can be explicitly attacked, and - on the other hand - offers an unambiguous interpretation of results (by its experimental accessibility). Some functional-analytic problems related to properties of Krein-symmetric operators are uncovered in the analysis.

MP 4.2 Di 15:25 JUR H

Generalised free fields in curved spacetime. — •Ko Sanders — Institute for theoretical physics, Göttingen (D)

Quantum field theory in curved spacetime can be conveniently formulated in the general axiomatic setting of locally covariant quantum field theory (LCQFT). We raise the question whether the local and (smoothly) covariant axioms of LCQFT reduce to Wightman field theory in Minkowski spacetime with all its analytic structure. This is of some interest, because no-go results like the Jost-Schroer Theorem in Wightman theory, which prevent the construction of interacting quantum fields, are often based on arguments involving analytic continuation.

We illustrate our question by the simplest example of a non-free quantum field: the generalised free scalar field. We give a local and covariant definition of these fields and discuss what non-local (but natural) assumption is needed to make them reduce exactly to the generalised free fields of Wightman theory. We especially point out where analytic continuation finds its origin.

MP 4.3 Di 15:50 JUR H

Analytical solutions of the geodesic equation in axially symmetric space-times — •Eva Hackmann and Claus Lämmerzahl — ZARM, Universität Bremen

In recent years, the theory of elliptic and hyperelliptic functions was rediscovered for the purpose of analytically solving geodesic equations in various space-times. In this talk we will present the general mathematical methods and illustrate the procedure for the example of the geodesic equation in Kerr and Kerr-de Sitter space-times, which can then easily be adapted to all type-D space-times.

MP 5: Quantum Information

Zeit: Dienstag 16:45–18:00 Raum: JUR H

MP 5.1 Di 16:45 JUR H

From quantum computation to quantum simulation: becoming more realistic. — •Dirk-Michael Schlingemann, Michael Keyl, and Zoltan Zimboras — ISI Foundation, Torino, Italy

The purpose of this talk is to introduce the basic tasks and goals of the EU FP7-project "COQUIT (Collective quantum operations for information technology)". Quantum systems are investigated which allow only a partial control by a constrained set of quantum operations. Typical examples are many particle quantum systems like cold atoms in optical lattices or other multi-atom ensembles, which can be manipulated collectively but not individually. Such restrictions are currently one of the biggest obstacles against working quantum computers. Instead of improving the corresponding experimental methods, we aim at a systematic study of the tasks which can be performed with currently available techniques. To this end we want to develop theoretical models which can on the one hand reflect the limitations of current experimental setups, but are on the other hand powerful enough to allow non-trivial practical applications. This point of view is new and complementary to most other research in quantum information science, where complete control over a small number of particles is assumed. One basic pillar of the COQUIT project is based on the concept of quantum simulation. Here a limited set of implementable operations is used to simulate physical properties of another quantum system. In this sense a quantum simulation device is a computational device for special purposes. We present the actual status of the project including new results and future perspectives.

MP 5.2 Di 17:10 JUR H

Entanglement distillation from quasifree Fermions — •Michael Keyl, Zoltan Kadar, and Dirk Schlingemann — ISI Foundation, 10133 Torino, Italy

Since Fermions are based on anti-commutation relations, their entanglement can not be studied in the usual way, such that the available theory has to be modified appropriately. Recent publications consider in particular the structure of separable and of maximally entangled states. In this talk we want to discuss local operations and entanglement distillation from bipartite, Fermionic systems. To this end we apply an algebraic point of view where algebras of local observables, rather than tensor product Hilbert spaces play the central role. We apply our scheme in particular to Fermionic Gaussian states where the whole discussion can be reduced to properties of the covariance matrix. Finally the results are demonstrated with free Fermions on an infinite, one-dimensional lattice.

MP 5.3 Di 17:35 JUR H

Quantum simulation of QFTs with discrete quantum systems — •Zoltan Zimboras, Michael Keyl, and Dirk-Michael Schlingemann — Quantum information group, ISI, Torino

Classical simulation of quantum many-body systems is usually very inefficient with long running times and with high needs for memory (e.g., it is not even possible to store classically the arbitrary state of 50 qubits). One might overcome these difficulities 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 discrete quantum systems that are relatively easy to prepare in labs (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? I will in particular show how (and in which sense) one can use the Holstein-Primakoff transformation to store continuous quantum information in a discrete quantum system, and after the storage how one can model the time-evolution of the continuous quantum system with a Quantum Cellular Automata action on the discrete system.

MP 6: Quantum Field Theory

Zeit: Mittwoch 8:30–9:45 Raum: JUR H

MP 6.1 Mi 8:30 JUR H

Supersymmetry and the Functional Renormalization Group — Jens Braun, Holger Gies, •Franziska Synatschke, and Andreas Wipf — Theoretisch-Physikalisches Institut, FSU Jena, Deutschland

Dynamical supersymmetry breaking is an important issue for applications of supersymmetry in particle physics. Many approaches to investigate this problem break supersymmetry explicitly and it is hard to distinguish between dynamical and explicit supersymmetry breaking. The functional renormalization group equations allow for a nonperturbative approach that leaves supersymmetry intact. Therefore they offer a promising tool to investigate the dynamical breaking of supersymmetry. In this talk we will employ this method to investigate the $N = 1$ Wess-Zumino model in three dimensions at finite temperature. We will recover many aspects of finite temperature QFT such as dimensional reduction and the the Stefan-Boltzmann law. Also we will discuss supersymmetry breaking through the thermal boundary conditions and the phase diagram for the breaking of the $\mathbb{Z}_2$-symmetry at finite temperatures.

MP 6.2 Mi 8:55 JUR H

Confinement in G_2 Gauge Theories — •Björn H. Wellegehausen, Christian Wozar, and Andreas Wipf — Theoretisch-Physikalisches Institut, FSU Jena

G_2 is the smallest simple and simply connected lie group with a trivial center. Therefore investigations of G_2 gauge theorie help to clarify the relevance of center symmetry for confinement. Beside this it has an intriguing connection to $SU(3)$ gauge theory. If one couples a scalar field in the fundamental representation to the gauge field one can break the G_2 gauge symmetry to $SU(3)$ gauge symmetry. The representation theory and its implications for confinement are reviewed and the full phase diagram of the gauge higgs model, obtained by monte carlo simulations, is presented.

MP 6.3 Mi 9:20 JUR H

On time-dependent resonances for the Dirac equation and their adiabatic behavior — •Nikodem Szpak — Fakultät für Physik, Universität Duisburg-Essen

Studying spontaneous particle creation in strong external (electromagnetic) fields of QED we face the problem of description of the time-dependent resonances for the Dirac equation and the lack of adiabatic theorems for such systems. We present our analytical and numerical approaches to this problem as well as concepts developed on the way to formulation of the corresponding adiabatic theorems.

MP 7: Hauptvortrag

Zeit: Mittwoch 14:00–14:50 Raum: JUR H

Hauptvortrag MP 7.1 Mi 14:00 JUR H

Bulk universality for Wigner random matrices — •Benjamin Schlein — DPMMS, University of Cambridge, Cambridge, UK

In this talk I am going to consider ensembles of NxN random matrices whose entries are, up to symmetry constraints, independent and identically distributed. Assuming sub-exponential decay of the matrix entries, I will present a proof of the universality of the local eigenvalue statistic; in the limit of large N the eigenvalue correlation functions are independent of the probability distribution of the entries and are determined by the symmetry of the matrix (hermitian, real symmetric, or symplectic).

MP 8: Quantum Mechanics

Zeit: Mittwoch 15:00–16:15 Raum: JUR H

MP 8.1 Mi 15:00 JUR H

Pseudorelativistic operators in the limit of strong magnetic fields — •Doris Jakubassa-Amundsen — Math. Institut, LMU München

Relativistic one-electron ions serve as a tool for probing the description of many-electron systems by means of pseudorelativistic operators. The two operators considered are the Chandrasekhar operator which allows for relativistic kinematics in place of the Laplace operator, and the no-pair Brown-Ravenhall operator which results from a projection of the Dirac operator onto the electronic subspace.

When the ions move in a locally bounded magnetic field of the type $(0, 0, B(|x_1|^d + |x_2|^d))$ with $d \geq 0$, both pseudorelativistic operators obey a scaling property which relates an increasing field B to a decreasing particle mass. It is strictly shown that, when B goes to infinity, the binding energy of the ground state (existing as a discrete state for $d \leq d_0$ where d_0 increases with nuclear charge) increases with a power law B^s with $s = 1/(2+d)$. This contrasts the logarithmic increase with B in the nonrelativistic ($d = 0$) case.

MP 8.2 Mi 15:25 JUR H

Regularity of Eigenstates in Regular Mourre-Theory — Jacob Møller[1] and •Matthias Westrich[1,2] — [1]Dept. of Mathematics, University of Aarhus, Denmark — [2]Institut für Mathematik, Johannes-Gutenberg Universität Mainz, Deutschland

Our presentation gives an abstract method for proving that eigenstates of a self-adjoint operator H lie in the domain of the conjugate operator A. Conjugation means here that H and A have a positive commutator in the sense of Mourre. The only requirement is the C^k-regularity of H.

Regarding integer k, our result is optimal. Using this method, we obtain cutoff-independent bounds and under a boundedness assumption of the multiple commutators we prove analyticity of the eigenstates with respect to $\exp(-itA)$.

We illustrate the relevance of this method in a physical application.

MP 8.3 Mi 15:50 JUR H

Rigorous Foundation of the Brockett-Wegner Flow — •Volker Bach[1] and Jean-Bernard Bru[2] — [1]Institut für Mathematik FB 08; Universität Mainz; 55099 Mainz — [2]Department of Mathematics, University of the Basque Country UPV/EHU, Leioa, Spain

The Brockett-Wegner flow was found independently by Brockett and Wegner in the early 1990ies to diagonalize self-adjoint matrices by a time-dependent Schrödinger equation. The lecture will discuss the mathematical foundation of this flow and its application to the diagonalization of quadratic operators in quantum field theory (a warm-up application which represents an alternative to a Bogolubov transformation).

MP 9: Quantum Field Theory

Zeit: Mittwoch 16:45–18:00 Raum: JUR H

MP 9.1 Mi 16:45 JUR H

Continuous spectrum of automorphism groups and particle aspects in QFT — •Wojciech Dybalski — Technical University of Munich, Germany

This talk presents a general framework for refined spectral analysis of a group of isometries acting on a Banach space, which extends the spectral theory of Arveson. The concept of continuous Arveson spectrum is introduced and the corresponding spectral subspace is defined. The absolutely continuous and singular-continuous parts of this spectrum are specified. Conditions are given, in terms of the transposed action of the group of isometries, which guarantee that the pure-point and continuous subspaces span the entire Banach space. In the case of a unitarily implemented group of automorphisms, acting on a C*-algebra, relations between the continuous spectrum of the automorphisms and the spectrum of the implementing group of unitaries are found. The group of spacetime translation automorphisms in QFT is analyzed in detail. In particular, it is shown that the structure of its continuous spectrum is relevant to the problem of existence of (infra-)particles in a given theory.

MP 9.2 Mi 17:10 JUR H

Geometric modular action for disjoint intervals and boundary conformal field theory — Roberto Longo[1], •Pierre Martinetti[2], and Karl-Henning Rehren[2] — [1]Università di Roma ”Tor Vergata” — [2]Universität Göttingen & Courant Centre

In suitable states, the modular group of local algebras associated with unions of disjoint intervals in chiral conformal quantum field theory acts geometrically. We translate this result into the setting of boundary conformal quantum field theory and interpret it as a relation between temperature and acceleration.

MP 9.3 Mi 17:35 JUR H

Connection between the renormalization groups of Stückelberg-Petermann and Wilson — •Michael Dütsch[1], Romeo Brunetti[2], and Klaus Fredenhagen[3] — [1]Courant Research Centre in Mathematics, Universität Göttingen — [2]Dipartimento di Matematica, Universita di Trento, Italien — [3]II. Institut für Theoretische Physik, Universität Hamburg

The Stückelberg-Petermann renormalization group (RG) relies on the non-uniqueness of the S-matrix in causal perturbation theory (i.e. Epstein-Glaser renormalization); it is the family of all finite renormalizations. The RG in the sense of Wilson refers to the dependence of the theory on a cutoff. A new formalism for perturbative algebraic quantum field theory allows to clarify the relation between these different notions of RG. In particular we relate the approach to renormalization in terms of Polchinski's Flow Equation to the Epstein-Glaser method.

MP 10: Noncommutative Geometry

Zeit: Donnerstag 8:30–9:20 Raum: JUR H

MP 10.1 Do 8:30 JUR H

Spectral Triples of Holonomy Loops — •Jesper Grimstrup — Niels Bohr Institute, Copenhagen, Denmark

In my talk I will review the construction of a spectral triple over a configuration space of connections. The spectral triple construction is related to quantum gravity since the interaction of the algebra with the Dirac type operator reproduces the structure of the Poisson bracket of General Relativity when formulated in terms of Ashtekar variables. I will show how the Dirac Hamiltonian in 3+1 dimensions emerge naturally from the construction in a semi-classical approximation. This indicates that the framework includes canonical matter degrees of freedom. Also, I will show how an operator is constructed which in the semi-classical limit gives the constraints of canonical gravity.

MP 10.2 Do 8:55 JUR H

Model Building in Noncommutative Geometry — •Christoph Stephan — Institut für Mathematik, Universität Potsdam

Noncommutative geometry (NCG) based on spectral triples allows to unify classical Yang-Mills-Higgs (YMH) theories and General Relativity in a single geometrical framework. The relevant spectral triples contain a finite part which encodes the particle content of the YMH models and is subject to strong geometrical restrictions. These restrictions permit a classification of certain (irreducible) spectral triples and lead to a prominent position of the Standard Model (SM) as a "minimal" finite spectral triple.

I will give a short introduction to the basic ideas of NCG and present a "bottom-up" approach to model building in the framework of NCG. This noncommutative model building kit has led to phenomenologically interesting models beyond the SM. These models extend the fermionic and the gauge sector of the SM as well as the scalar sector.

MP 11: Noncommutative Geometry

Zeit: Donnerstag 9:30–10:20 Raum: JUR H

MP 11.1 Do 9:30 JUR H

Algebraic approach to quantum field theory on a class of noncommutative curved spacetimes — Thorsten Ohl and •Alexander Schenkel — Lehrstuhl für Theoretische Physik II, Universität Würzburg, 97074 Würzburg, Deutschland

In this talk (based on arXiv:0912.2252[hep-th]) we explain how to construct the quantum field theory of a free real scalar field on a class of noncommutative manifolds, obtained via deformation quantization using triangular Drinfel'd twists. We define action functionals in the framework of twist-deformed differential geometry, derive the associated equations of motion and solve them in terms of formal power series. In analogy to the commutative case, we can construct the Weyl algebra of field observables, which depends in general on the deformation of spacetime. We give an outlook to applications of our approach to noncommutative cosmology and black hole physics.

MP 11.2 Do 9:55 JUR H

Instantons in Noncommutative Gauge Theory in Four Dimensions on the Lattice — Arifa Ali Khan[1] and •Harald Markum[2] — [1]University of Taiz, Yemen — [2]Vienna University of Technology, Austria

Theories with noncommutative space-time coordinates represent alternative candidates of grand unified theories. We discuss U(1) gauge theory in 2 and 4 dimensions on a lattice with N sites. The mapping to a U(N) plaquette model in the sense of Eguchi and Kawai can be used for computer simulations. In 2D it turned out that the value of the topological charge is decreasing during a Monte Carlo history. This shows that the topological charge is in general supressed. The situation is similar to lattice QCD where gauge field configurations are topologically trivial and one needs to apply some cooling procedure on the gluons to unhide the integer number of the instantons. In 4D the definition of a monopole observable seems to be 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. Concerning the topological charge it seems straightforward. One can transcribe the plaquette and hypercube formulation to the matrix theory. There are several possible choices of noncommutativity amoung the six planes in 4D. The simplest is to use two noncommutative coordinates. One has to modify the Monte Carlo update correspondingly. It will be interesing to measure the topological charge in the non/commutative plane and in the hypercube.

MP 12: Hauptvortrag

Zeit: Donnerstag 14:00–14:50 Raum: JUR H

Hauptvortrag MP 12.1 Do 14:00 JUR H

Conformal field theory with boundaries — •Ingo Runkel — Universität Hamburg, Germany

Two-dimensional conformal field theory describes the critical behaviour of two-dimensional statistical systems or one-dimensional quantum systems, and it provides the world sheet description of string theory. In all of these situations it is natural to consider the theory in the presence of a boundary. I would like to present some surprising outcomes of the study of the boundary degrees of freedom. For example, in a class of models called rational conformal field theories, knowledge of the boundary theory already allows to deduce which bulk theory it belongs to. In other words, the correlators involving only fields inserted at the boundary allow to infer the space of local fields in the bulk and their correlators. Since the boundary theory is often simpler than the bulk theory, this insight is also helpful in the construction and classification of conformal field theories.

MP 13: Quantum Field Theory

Zeit: Donnerstag 15:00–16:15 Raum: JUR H

MP 13.1 Do 15:00 JUR H

New Aspects of Conformal Symmetry in 3+1 Dimensions — •Karsten Busse — Nat.Fak. II, Physik/Chemie, Martin-Luther-Universität Halle-Wittenberg, 06099 Halle (Saale)

It is known since one hundred years, that the conformal group C(1,3) is the space symmetry group of electromagnetism. With the success of Dirac's spinor equation for the description of electron and other leptons, it was also tried to apply C(1,3), but masses introduce a scale to the theory, which is in contradiction to the dilation invariance of C(1,3). To obtain scale invariance, the masses must be related to other phaenomena (like symmetry breaking) or new particles (e.g. dilaton, Higgs). Another approach using conformal symmetry is the introduction of twistors in 4+2 dimensions, the covering space of the linearized conformal group.

It will be shown, that by using a conformal spinor, a conform invariant Lagrangean can be constructed without external fields, including a conventional mass term. With respect to Lorentz-Transformations, this spinor behaves like a Dirac spinor, but dilation, translation and special conformal transformations induce differences. The coupling to gauge bosons is not affected and can be included into the theory just the same way as in Dirac theory. The conformal transformation symmetry can be broken by a simple transformation, which leads to left handed Dirac particle, but with a chiral mass component.

MP 13.2 Do 15:25 JUR H

Deterministic field theory from dynamic compact space-time dimensions — •Donatello Dolce — ThEP, Mainz

We propose an unexplored quantization method in field theory. It is based on the assumption of dynamic space-time intrinsic periodicities for relativistic fields, which in turn can be regarded as dual to extra-dimensional fields. In a generalization of the AdS/CFT correspondence, we obtain a unified and consistent interpretation of Special Relativity and Quantum Mechanics in terms of Deterministic Geometrodynamics.

MP 13.3 Do 15:50 JUR H

Deducing the three gauge interactions from the three Reidemeister moves — •Christoph Schiller — München

We give one of the first known arguments for the origin of the three observed gauge groups. The argument is based on modelling nature at Planck scales as a collection of featureless strands that fluctuate in three dimensions. This approach models vacuum as untangled strands and particles as tangles of strands.

Modelling vacuum as untangled strands implies the field equations of general relativity, when applying an argument from 1995 to the thermodynamics of strands. Modelling fermions as tangles of two or more strands allows to define wave functions as time-averages of strand crossings; using an argument from 1980, this allows to deduce the Dirac equation.

When modelling fermions as tangled strands, gauge interactions appear naturally as deformation of tangle cores. The three possible types of observable core deformations are given by the three Reidemeister moves. They naturally lead to a U(1), a broken and parity-violating SU(2) and a SU(3) gauge group.

The model is unique, is unmodifiable, is consistent with all known data, and makes numerous testable predictions, including the absence of other interactions, of grand unification and of higher dimensions. A method for calculating coupling constants seems to appear naturally.

The page www.motionmountain.net/research provides additional details.