Fachverband Theoretische und Mathematische Grundlagen der Physik (MP)

Karl-Henning Rehren
Institut für Theoretische Physik, Univ. Göttingen
rehren@theorie.physik.uni-goettingen.de

Übersicht der Hauptvorträge und Fachsitzungen

(Hörsaal HS 8; Poster OG)

Hauptvorträge

MP 6.1	Mi	14:00–14:40	HS 8	**Modern foundations for thermodynamics, the matter-gravity entanglement hypothesis and the stringy limit of black-hole equilibria** — •Bernard S. Kay
MP 8.1	Mi	16:30–17:10	HS 8	**Hawking radiation as a local tunneling process: algebraic QFT viewpoint** — •Valter Moretti
MP 10.1	Do	11:15–11:55	HS 8	**Five-dimensional gauge theories on the lattice** — •Francesco Knechtli
MP 12.1	Do	14:00–14:40	HS 8	**Spontaneous supersymmetry breaking on the lattice** — •Urs Wenger

Hauptvorträge des Symposium SYNU

Das vollständige Programm dieses Symposiums ist unter SYNU aufgeführt.

SYNU 1.1	Do	16:30–17:00	HS 2	**Trends in Numerical Mathematics** — •Wolfgang Hackbusch
SYNU 1.2	Do	17:00–17:30	HS 2	**Challenges in Numerical Astrophysics: Modeling the Formation of Stars** — •Ralf Klessen
SYNU 1.3	Do	17:30–18:00	HS 2	**Black Holes on the Computer** — •Thomas Baumgarte
SYNU 1.4	Do	18:00–18:30	HS 2	**Astrophysical simulations of gas dynamics with ionising radiation transport** — •Jonathan Mackey

Fachsitzungen

MP 1.1–1.4	Di	11:15–12:35	HS 8	**Verschiedenes**
MP 2.1–2.4	Di	14:00–15:40	HS 8	**Quanteninformation**
MP 3.1–3.2	Di	16:30–17:20	HS 8	**Quantenfeldtheorie**
MP 4.1–4.2	Di	17:30–18:20	HS 8	**Nichtkommutative Geometrie**
MP 5.1–5.2	Di	8:00–18:00	Poster OG	**Poster 1**
MP 6.1–6.1	Mi	14:00–14:40	HS 8	**Quanten+Gravitation HV 1**
MP 7.1–7.3	Mi	14:45–16:00	HS 8	**Quanten+Gravitation 1**
MP 8.1–8.1	Mi	16:30–17:10	HS 8	**Quanten+Gravitation HV 2**
MP 9.1–9.3	Mi	17:15–18:30	HS 8	**Quanten+Gravitation 2**
MP 10.1–10.1	Do	11:15–11:55	HS 8	**Gitterfeldtheorie HV 1**
MP 11.1–11.2	Do	12:00–12:50	HS 8	**Gitterfeldtheorie 1**
MP 12.1–12.1	Do	14:00–14:40	HS 8	**Gitterfeldtheorie HV 2**
MP 13.1–13.3	Do	14:45–16:00	HS 8	**Gitterfeldtheorie 2**
MP 14.1–14.2	Do	8:00–18:00	Poster OG	**Poster 2**

Mitgliederversammlung des Fachverbandes MP

Mittwoch 18:30–19:30 HS 8

- Bericht
- Sektion "Materie und Kosmos"
- Wahl des Beirats

- Wahl des Leiters
- Tagungen
- Verschiedenes

MP 1: Verschiedenes

Zeit: Dienstag 11:15–12:35 Raum: HS 8

MP 1.1 Di 11:15 HS 8

Quantized magnetic flux through the orbits of hydrogen-like atoms — •Wolf-Dieter R. Stein — Helmholtz-Zentrum Berlin für Materialien und Energie, Hahn-Meitner-Platz 1, D-14109 Berlin

I report on the investigation of the quantization of the magnetic flux through the orbits of the hydrogen atom on the basis of the Rutherford-Bohr model of the atom. In contrast to earlier studies based on magnetic fields originating from the magnetic moment of the proton, here the origin of the magnetic flux is taken to be the orbiting electron itself. The magnetic moment of the proton causes an additional magnetic flux through the atomic orbits resulting in small energy shifts of the atomic levels, which are studied in more detail. The energy difference due to opposite directions of the magnetic moment of the proton results in a fractional amount of 3/8 of the hyperfine level splitting of the lowest Bohr orbit. Such a ratio was also observed for the fine structure energy level splitting when the spin of the electron is neglected. Generalizations will be discussed.

MP 1.2 Di 11:35 HS 8

Mathematische Modellierung charakteristischer Rauscheinflüsse auf MOSFET-Transistoren — •Sonja Engert, Ralf Granzner, Frank Schwierz und Hannes Töpfer — TU Ilmenau

Silizium-MOSFETs gehören zu den Grundelementen in integrierten Logikschaltungen. Ein gebräuchlicher Weg zur Steigerung der Energieeffizienz ist die Verringerung der Signalpegel, was zu dem sogenannten Subthreshold-Betrieb führt. Ein Vorteil dieser Maßnahme ist, dass sie auf die gebräuchlichen Strukturen angewendet werden kann. Allerdings führt die Verringerung des Signalpegels zur Verschlechterung des Signal-Rausch-Verhältnisses. Für jeden Transistor lassen sich ein Ein- und ein Aus-Zustand als zwei beliebige Punkte auf der Übertragungskennlinie definieren. In dieser Arbeit wurden zwei verschiedene Rauscharten hinsichtlich der Auswirkung auf diese Zustände mathematisch untersucht. Das thermische Rauschen ist, wurde als gaußverteiltes Ausgangssignal (Drain-Strom) modelliert. Es beeinflusst das Zustandsverhalten im gesamten Bereich der Gatespannung. Das Random-Telegraph-Rauschen (RTN) wird durch Traps an der Grenzfläche zwischen Gateoxid und Kanal verursacht, welche entsprechend der Ladungsträgerstatistik entweder geladen oder neutral sein können. Es bewirkt ein zufälliges Hin- und Herschalten des Drainstromes zwischen zwei festen Pegeln bei konstanter Gatespannung. Dieser Rauscheinfluss wirkt entweder auf den Ein- oder auf den Aus-Zustand, je nach Polarisierung des Traps. Es wird eine Methode demonstriert, anhand derer sich Aussagen treffen lassen, in welchem Bereich die Gatespannung bei bekannten Transistoreigenschaften und RTN-Pegel liegen darf.

MP 1.3 Di 11:55 HS 8

What Does Go Wrong with Field Theories? Alternatives to 6 Points Worth to Be Rediscussed — •Claus Birkholz — Seydelstr. 7, D-10117 Berlin

Insufficiency complaints at most are ranging about singularities or the arbitrariness of input assumptions, which might be controlled but not satisfactorily founded:

a. The infinitesimal calculus is promoting continuous models - ignoring error bars confining basic physics to finite, atomistic models.

b. The variation principle, once good for point mechanics, introduced hosts of arbitrary parameters instead of relying on consistent correlations by Clebsch-Gordon coefficients.

c. And cosmologists, tightly sticking to diff. geometry, are strictly ignoring the implications of group theory.

The latter point prevented the quantization of space-time and general relativity for a century. Quantum gravity with its far-reaching implications as propagated since 2010, however, still did not yet arrive at most institutes officially.

Six main problems of field theories are traced back to their roots:

1. Infrared singularities.
2. Inconsistencies resulting from Kronecker deltas.
3. Ultraviolet singularities.
4. Arbitrary coupling constants.
5. The variation principle, basic to the "standard model".
6. Mathematical limits (implying infinities).

MP 1.4 Di 12:15 HS 8

Struktur und Bewertung des Universums über die E8-Gruppe — •Sadler Norbert — Wasserburgerstr. 25a, 85540 Haar

Durch Anwendung gruppenth. Methoden, insbesondere der E8-Grp., auf den Makro-u.den Mikrokosmos werden neue Zugänge zum Verständnis und der Bewertung in den Bereichen der Kosmologie,der Teilchenphysik, der Gravitation, der Vereinheitlichung der 4 Naturkräfte und der Interpretation der LHC-Ergebnisse aufgezeigt. Exemplarisch werden einige Ergebnisse offen gelegt und zur Diskussion gestellt.

Def.: E8 besitzt 248 Freih.Grade in der Drehung eines 57dim. geom. Objektes. Die 248 Freih.Grade bilden die Anzahl der "Feynman Pfade" und das 57dim. Objekt den "Entitätenkörper" ab.

Die Ergebnisse:

(i) Die kosm. Strukturgleichungen: 248=1/(5/9 alfa(QED); 124 x (4.13/9) = 57 dim. Objekt und 248 = (4/9) (1.5 10**80 Prot.i. Univ.) x (4Pi/3) x Betrag(t(Pl.)(l(Pl.)), mit 4/9 = Aufenth. Wahrsch. einer Entität auf 1m, 5/9 keine Entität.

(ii) Die Massen der Elementarteilchen: m(Prot.) = (h/4Pi) x (sinh57) / 1s; m(Elektr.) = alfa(QED)/(32x4/9).

(iii) Die Vereinheitl. alfa(Vereinh.) = Pi(57 dim. Kug. Vol. / 57 dim. Würf. Vol.) / c = 2.3x10**-43

(iv) Im LHC wurden zwei 57 dim. Objekte destabilisiert: 2 x (57(1 + alfa(QCD)/2)) 1GeV = 125.4 GeV; Die Massenbildung erfogte über das 57 dim. Objekt und nicht duch das "Higgsfeld"!

MP 2: Quanteninformation

Zeit: Dienstag 14:00–15:40 Raum: HS 8

MP 2.1 Di 14:00 HS 8

The Magic Power of Combining Coherent Control with Switchable Markovian Noise Amplitudes — •Thomas Schulte-Herbrüggen[1] and Ville Bergholm[2] — [1]Dept. Chem., TU-München — [2]Institute for Scientific Interchange Foundation

Adding bang-bang switchable noise on a single qubit (out of a total of n) on top of unitary control seems magic: For amplitude-damping noise (non-unital) this simple add-on suffices for acting transitively on the set of *all* density operators. So one can transform *any initial state* into *any desired target state*. For bit-flip noise (unital), the add-on allows for reaching any target state *majorised* by the initial state [1].

In the Lie-semigroup framework of Markovian open systems, we also show that for *state transfer* our Markovian open-loop scheme [1] is as powerful as measurement-based closed-loop control schemes designed to embrace non-Markovian evolution [2].

We have extended our open-loop optimal control algorithm (dynamo) by incoherent control so that these unprecedented reachable sets can systematically be exploited in experiments [1]. As illustrated for an ion trap experimental setting, open-loop control with noise switching can thus simplify the more complicated measurement-based closed-loop feedback schemes [2,3,4] requiring a resettable ancilla qubit.

[1] V. Bergholm and T. Schulte-Herbrüggen, arXiv/1206.4945 (2012)
[2] S. Lloyd and L. Viola, Phys. Rev. A **65**, 010101 (2001)
[3] J. Barreiro et al., Nature **470**, 486 (2011)
[4] P. Schindler et al., arXiv/1212.2418 (2012)

MP 2.2 Di 14:25 HS 8

The geometry of tensor network states — •Tobias Osborne[1], Jutho Haegeman[2], Michaël Mariën[3], and Frank Verstraete[2] — [1]Institute of Theoretical Physics, Leibniz Universität Hannover, Germany — [2]Vienna Center for Quantum Science and Technology, Faculty of Physics, University of Vienna, Austria — [3]Faculty of Physics and Astronomy, University of Ghent, Belgium

We study the geometric properties of the manifold of states described

as tensor network states (TNS). Due to parameter redundancies TNS often have the mathematical structure of a (principal) fiber bundle. The total space or bundle space corresponds to the parameter space, i.e., the space of tensors associated to every physical site. The base manifold is embedded in Hilbert space and can be given the structure of a Kähler manifold by inducing the Hilbert space metric. Our main interest is in the states living in the tangent space to the base manifold, which have recently been shown to be interesting in relation to variational methods for time dependence and elementary excitations.

MP 2.3 Di 14:50 HS 8

On the Differential Geometry of Fixpoint Engineering in Markovian Open Quantum Systems — •Corey O'Meara[1], Gunther Dirr[2], and Thomas Schulte-Herbrüggen[1] — [1]Dept. Chem., TU-München — [2]Inst. Math., University of Würzburg

In quantum memories and practical quantum control, recent focus has been on steering the open quantum system into desired fixed points.

Here we give a complete account of Lie semigroups (of controlled Markovian quantum systems) and their fixpoint sets in terms of their Lindbladian generators in the corresponding Lie wedge. For n-qubit systems, we parameterise *all* Lindblad generators sharing a desired fixed point. We also give a constructive overview how to make this fixed point unique. Building upon our classification thus facilitates to choose the simplest Markovian experimental implementation to arrive at any desired fixed point.

MP 2.4 Di 15:15 HS 8

Lie-theoretic results in (unitary) Quantum Control Theory — •Zoltán Zimborás[1,2], Robert Zeier[3], Michael Keyl[2], and Thomas Schulte-Herbrüggen[3] — [1]Department of Theoretical Physics, University of the Basque Country UPV/EHU, Bilbao, Spain — [2]Institute for Scientific Interchange Foundation, Torino, Italy — [3]Department of Chemistry, Technical University of Munich (TUM), Garching, Germany

We shortly review the Lie-theoretic framework of quantum control theory. In particular, conditions for full controllability and pure state reachability both in the presence and in the absence of symmetries are discussed. Finally, we mention concrete applications concerning translation-invariant and fermionic systems.

[1] Zoltán Zimborás, Robert Zeier, Michael Keyl, Thomas Schulte-Herbrüggen, *A Dynamic Systems Approach to Fermions and Their Relation to Spins*, arXiv:1211.2226

MP 3: Quantenfeldtheorie

Zeit: Dienstag 16:30–17:20 Raum: HS 8

MP 3.1 Di 16:30 HS 8

Gauge-fixing and the Gribov-Singer ambiguity — •Axel Maas — Institute for Theoretical Physics, University of Jena, Germany

Gauge-fixing is a useful tool in intermediate steps of calculations in quantum gauge field theories. However, in non-Abelian gauge theories it is complicated non-perturbatively by the Gribov-Singer ambiguity.

Several aspects of this ambiguity and proposals for its resolution in the class of Landau gauges will be presented, especially in view of the necessity to perform the same type of gauge-fixing both in the continuum and on the lattice. This has implications also for global residual gauge symmetries, like the BRST symmetry or the breaking of global symmetries by the Higgs mechanism.

MP 3.2 Di 16:55 HS 8

Supersymmetric O(N) models in d=3 with functional renormalization group (FRG) methods — •Tobias Hellwig[1], Marianne Heilmann[1], Andreas Wipf[1], and Daniel F. Litim[2] — [1]Theoretisch-Physikalisches Institut, Friedrich-Schiller-Universit Jena, Max-Wien-Platz 1, D-07743 Jena, Germany — [2]Department of Physics and Astronomy, University of Sussex, BN1 9QH, Brighton, UK

While a lot of results concerning scalar O(N) models are known, much less is known for supersymmetric O(N) models. The 1/N expansions were examined in some earlier works with the help of the Hartree-Fock approximation.

In this talk results for all N are presented. These results were obtained by using FRG methods and a manifest supersymmetric regulator.

For finite N fixed point solutions and critical exponents are obtained. We will comment on effects of different truncations in the effective average action. Starting point is the LPA approximation. In a second step a wave function renormalization is included and deviations from LPA solution are discussed. This will be done for a field dependent and field independent form of the wave function renormalization. This knowledge could also prove to be helpful for further FRG studies of supersymmetric theories.

MP 4: Nichtkommutative Geometrie

Zeit: Dienstag 17:30–18:20 Raum: HS 8

MP 4.1 Di 17:30 HS 8

Noncommutative Geometry in the LHC-Era — •Christoph Stephan — Institut für Mathematik, Universität Potsdam, Germany

Noncommutative geometry (NCG) allows to unify the basic building blocks of particle physics, Yang-Mills-Higgs theory and General relativity, into a single geometrical framework. The resulting effective theory constrains the couplings of the Standard Model (SM) and reduces the number of degrees of freedom.

After briefly introducing the basic ideas of NCG, I will present its predictions for the SM and the few known models beyond the SM. Most of these models, including the Standard Model, are now ruled out by LHC data. But interesting extensions of the SM which agree with the presumed Higgs mass and predict new particles are still very much alive and await further experimental data.

MP 4.2 Di 17:55 HS 8

Deformations in Quantum mechanics — •Albert Much — MPI MIS, Leipzig, Deutschland

We consider deformations of quantum mechanical objects, and use the novel construction of warped convolutions for deformation. It turns out that through the deformation we are able to obtain several quantum mechanical effects where electromagnetic fields play a role. We understand the magnetic field as an object which is the outcome of strict mathematical deformation. Furthermore, we are able to obtain all magnetic fields by using this method of deformation. The results are used in quantum field theory to obtain an effective quantum plane.

MP 5: Poster 1

Zeit: Dienstag 8:00–18:00 Raum: Poster OG

MP 5.1 Di 8:00 Poster OG

Modifikation der Stokes-Gleichung für die Bewegung von Luftblasen in einer viskosen Flüssigkeit. — •Heinz Preuss — Hameln

Im Anschluss an vorausgehende Mitteilungen (Vortrag DD 16.6 Münster 2011, Poster DY 22.22 Berlin 2012) wird in Anlehnung an die Herleitung von Sommerfeld (Arnold Sommerfeld, Vorlesungen über theoretische Physik, Band 2: Mechanik der deformierbaren Medien. Leipzig

1945, S. 237 f.) nach Abänderung der Grenzbedingungen unter Einfügung eines Faktors a (vorgeschlagen von T. Krüger, Eindhoven) das Geschwindigkeitsfeld um eine bewegte Kugel (Geschwindigkeitsbetrag: v_o) berechnet und daraus eine modifizierte Stokes-Gleichung hergeleitet. Für die meridionale Geschwindigkeit der als die ruhende Kugel mit dem Radius R umströmend gedachten Flüssigkeit wird bei r = R gesetzt: v_θ = -a$v_o$sinθ (Sommerfeld: 0); v_r = 0; für r => unendlich: v_r = $v_o$cosθ, v_θ = -$v_o$sinθ. Nach Integration über die Druckanteile folgt: F_w = k2$\pi\eta$Rv_o mit k = 3-2a. Für die starre Kugel (a = 0) wird k = 3 (Stokes-Gleichung). Der Ansatz a = 1 (DY 22.22) ergibt mit k = 1 F_w um den Faktor 3 kleiner als bei Stokes. Die nach den Experimenten vermutete Reduzierung der Widerstandskraft um den Faktor 2 würde mit k = 3/2 realisiert, und für den Flexibilitätsfaktor ergäbe sich: a = 3/4. Das heißt: Die Luftblase nimmt die Flüssigkeit am Äquator mit der Geschwindigkeit v_o/4 mit. Dies wäre zu prüfen. Bemerkenswert: v_o/4 ist die kleinste Mitnahmegeschwindigkeit, bei der in der Äquatorebene v_θ mit wachsendem r monoton ansteigt und asymptotisch gegen v_o geht.

MP 5.2 Di 8:00 Poster OG

Why Current Field Theories Are Doomed to Failure — •Claus Birkholz — Seydelstr. 7, D-10117 Berlin

Current field theories developed historically, in a bottom-up way. By appending one balcony after the other to old conceptions, the grand direction seems to have got lost meanwhile. This poster is outlining another, a top-down procedure starting with the most fundamental group-theoretical implications on general relativity (GR) and on quantum field theories (QFT's). Thus, it stopped systematically to preclude physics from answering the great questions.

Field theories are demonstrated to tumbling from one inconsistency to the next one, culminating in the "standard model", which is fitting hosts of parameters without scrutinizing if there is no better system to be fitted.

The most obvious example is quantum gravity, whose installation of a fully quantized GR failed since a century by the only reason that a bent space-time has not yet been accepted to be the simple result of a non-linear condition (2nd-order SU(2,2)-Casimir) leaving untouched the superposition principle of linear quantum theories.

And QFT's are suffering under their ignorance of (Kronecker-) singlets.

MP 6: Quanten+Gravitation HV 1

Zeit: Mittwoch 14:00–14:40 Raum: HS 8

Hauptvortrag MP 6.1 Mi 14:00 HS 8

Modern foundations for thermodynamics, the matter-gravity entanglement hypothesis and the stringy limit of black-hole equilibria — •Bernard S. Kay — Department of Mathematics, University of York, York YO10 5DD, UK

In 1998, I pointed out that many puzzles, including the black-hole Information Loss Puzzle, the Schroedinger Cat Puzzle and older puzzles connected with entropy and the Second Law, would all seem to be resolvable with the Matter-Gravity Entanglement Hypothesis. I.e. that the proper framework for resolving all these puzzles is a conventional quantum mechanical theory of (low-energy) quantum gravity, the total state of a closed system is a pure state and the closed system's physical entropy is to be equated with its matter-gravity entanglement entropy.

In this talk, I point out that this hypothesis seems to fit well with modern work (since around 2006) on the foundations of Statistical Mechanics which replaces the traditional explanation for the thermality of a small system weakly coupled to an energy bath in terms of a total microcanonical state by an explanation in terms of a total state which is a random pure state with energy in a given narrow range. I also present new results which generalize this modern work and enable the computation of probable system-energy bath entanglement entropies as a function of total energy.

Relying on these new results, I then argue that the post-1996 explanations of black hole entropy in terms of the logarithm of the degeneracy of certain string states should be and can be modified so as to be consistent with the matter-gravity entanglement hypothesis.

MP 7: Quanten+Gravitation 1

Zeit: Mittwoch 14:45–16:00 Raum: HS 8

MP 7.1 Mi 14:45 HS 8

Invariant Connections and symmetry Reduction in Loop Quantum Gravity — •Maximilian Hanusch — Univ. Paderborn

The notion of invariant connections on principal fibre bundles plays a crucial role for symmetry reduction in particular in the framework of loop quantum gravity. Usually symmetries are represented by Lie groups of automorphisms of the underlying bundle. The corresponding invariant connections then provide a starting point for the construction of a reduced quantum configuration space. In this talk we will introduce a rather algebraic characterization of such connections that often allows for explicit calculations. We apply this result to the isotropic connections to be used in loop quantum cosmology. If time permits, we will highlight an alternative way to define a reduced quantum configuration space.

MP 7.2 Mi 15:10 HS 8

Hamiltonian dynamics of a quantum of space: hidden symmetries and spectrum of the volume operator, and discrete orthogonal polynomials — Vincenzo Aquilanti[1], •Dimitri Marinelli[2], and Annalisa Marzuoli[3] — [1]Dipartimento di Chimica, Università di Perugia and I.M.I.P., C.N.R. Roma, Italy — [2]Dipartimento di Fisica, Università degli Studi di Pavia and INFN, Sezione di Pavia, Italy — [3]Dipartimento di Matematica 'F. Casorati', Università degli Studi di Pavia, and INFN, Sezione di Pavia, Italy

The action of the quantum mechanical volume operator, introduced in connection with a symmetric representation of the three-body problem and recently recognized to play a fundamental role in discretized quantum gravity models, can be given as a second order difference equation which, by a complex phase change, we turn into a discrete Schrödinger-like equation. The introduction of discrete potential-like functions reveals the surprising crucial role here of the Regge symmetries, first discovered for the quantum mechanical 6j symbols; insight is provided into the underlying geometric features. The spectrum and wavefunctions of the volume operator are discussed from the viewpoint of the Hamiltonian evolution of an elementary "quantum of space", and a transparent asymptotic picture emerges of the semiclassical and classical regimes. The definition of coordinates adapted to Regge symmetry allows the construction of a novel set of discrete orthogonal polynomials.

MP 7.3 Mi 15:35 HS 8

Towards brane-worlds in Yang-Mills matrix models — •Harold Steinacker — Fakultät für Physik, Universität Wien

Brane solutions of Yang-Mills matrix models with 4 noncompact directions are discussed, focusing on the dynamics of the geometry and the low-energy physics on such branes. We show that matter leads to a perturbation of the 4-dimensional geometry and to some type of effective gravity in the matrix model, without invoking an Einstein-Hilbert term. This requires the presence of compactified extra dimensions with extrinsic curvature. We also sketch how the field content of the standard model fields can be realized in such a scenario.

MP 8: Quanten+Gravitation HV 2

Zeit: Mittwoch 16:30–17:10 Raum: HS 8

Hauptvortrag MP 8.1 Mi 16:30 HS 8

Hawking radiation as a local tunneling process: algebraic QFT viewpoint — •Valter Moretti — Department of Mathematics, Trento University, Povo (Trento), Italy

Some recent results are presented about the local tunnelling interpretation of the black hole radiation from the viewpoint of algebraic quantum field theory in curved spacetime. In particular it will be stressed how the phenomenon is independent from any particular self interaction of the field. The attempt to analyze the phenomenon exploiting the locally covariant renormalization procedure in curved spacetime will be also illustrated. It will be stressed that, at least referring to the toy model of Rindler spacetime, and for the phi^3 model, the black hole radiation survives the appearance of the interaction at one-loop. (Talk partially based upon: V. Moretti, N. Pinamonti, Commun. Math. Phys. 309 (2012) 295-311)

MP 9: Quanten+Gravitation 2

Zeit: Mittwoch 17:15–18:30 Raum: HS 8

MP 9.1 Mi 17:15 HS 8

Fermions in curved space — •Stefan Lippoldt and Holger Gies — Theoretisch-Physikalisches Institut, Jena, Deutschland

The Dirac equation gives rise to the Clifford algebra for the Dirac γ matrices, which holds also in curved spacetime. This algebra is invariant under diffeomorphisms as well as local spin base transformations $SL(4,\mathbb{C})$. It is shown that there exists a formalism due to A. Weldon in which the necessary covariant derivative can be constructed from the γ matrices itself without recourse to a vierbein construction. The well-known vierbein formalism is included as a special gauge choice for the γ matrices. We use this formalism to study symmetry breaking transitions of fermion systems on curved space.

MP 9.2 Mi 17:40 HS 8

Mode decomposition and Fourier analysis of physical fields in homogeneous cosmology — •Zhirayr Avetisyan — Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany — Institut für Theoretische Physik, Universität Leipzig, Germany

The methods of mode decomposition and Fourier analysis of quantum fields on curved spacetimes previously available mainly for the scalar fields on Friedman- Robertson-Walker spacetimes are extended to arbitrary vector fields on general spatially homogeneous spacetimes. This is done by developing a rigorous unified framework which incorporates mode decomposition, harmonic analysis and Fourier analysis. Explicit constructions are performed for a variety of situations arising in homogeneous cosmology. A number of results concerning classical and quantum fields known for very restricted situations are generalized to cover almost all cosmological models.

MP 9.3 Mi 18:05 HS 8

Diffeomorphism invariant quantum fields in perturbative algebraic quantum field theory — •Katarzyna Rejzner — University of Rome Tor Vergata, Italy

In this talk I will discuss the notion of diffeomorphism invariant quantities in locally covariant quantum field theory. This is important especially in the context of quantum gravity. In the paper "Batalin-Vilkovisky formalism in the functional approach to classical field theory" of K. Fredenhagen and myself from 2011 we proposed to define diffeomorphism invariant classical fields with the use of a certain generalization of the Batalin-Vilkovisky formalism. Here I will present a similar result which was obtained recently also for quantum fields.

MP 10: Gitterfeldtheorie HV 1

Zeit: Donnerstag 11:15–11:55 Raum: HS 8

Hauptvortrag MP 10.1 Do 11:15 HS 8

Five-dimensional gauge theories on the lattice — •Francesco Knechtli — Department of Physics, Bergische Universität Wuppertal, Germany

Five-dimensional gauge theories play a role in extensions of the Standard Model, where (some of) the fifth dimensional components of the gauge field are identified with a Higgs field. Due to the non-renormalizability, a finite ultra-violet cut-off has to be introduced. The formulation on a Euclidean lattice is a natural choice which preserves the gauge symmetry. Away from the perturbative regime, these theories can be studied by means of a mean-field expansion and by Monte Carlo simulations. We will present and compare results from these methods for SU(2) gauge theories with periodic and orbifold boundary conditions, in particular concerning dimensional reduction and the Higgs mechanism.

MP 11: Gitterfeldtheorie 1

Zeit: Donnerstag 12:00–12:50 Raum: HS 8

MP 11.1 Do 12:00 HS 8

Excited state systematics in extracting nucleon electromagnetic form factors from the lattice — •Thomas Rae[1], Stefano Capitani[1,2], Georg von Hippel[1], Hartmut Wittig[1,2], Benjamin Jäger[1,2], Harvey Meyer[1,2], Bastian Knippschild[1], and Michele Della Morte[1,2] — [1]PRISMA Cluster of Excellence and Institut für Kernphysik, University of Mainz, Germany — [2]Helmholtz Institute Mainz, University of Mainz, Germany

We present recent results for the nucleon electromagnetic form factors using lattice QCD. This includes the determination of the charge radii. The standard approach is to extract the form factors via a plateau fit to the lattice data using a 'large-enough' time separation between the operators at the source and sink. To check that this removes excited state contaminations to an acceptable level, we employ two further extraction methods: a fit that explicitly accounts for the contamination; and the use of a summed operator insertion, which suppresses the contamination. A comparison of the methods allows for the study of systematic effects related to excited state contributions entering in the q^2 dependence of the form factors. We employ the CLS ensembles using non-perturbatively $O(a)$ improved Wilson fermions in $N_f = 2$ QCD.

MP 11.2 Do 12:25 HS 8

Monte-Carlo study of the density of states in graphene with Coulomb interactions — •Pavel Buividovich — Regensburg University, D-93053 Regensburg

I report on the numerical studies of the electronic properties of monolayer graphene, which were done by applying Hybrid Monte-Carlo techniques to the tight-binding model of graphene. The density of states

was calculated from the particle number susceptibility with respect to the chemical potential. The results indicate that the Fermi velocity of charge carriers quickly increases as the interactions are turned on. As well, the logarithmic Fraunhofer singularity in the density of states, which is associated with the saddle point in the dispersion relation, becomes much more pronounced. I also discuss the interpretation of these findings in view of the recent experimental studies of the density of states in suspended graphene.

MP 12: Gitterfeldtheorie HV 2

Zeit: Donnerstag 14:00–14:40 Raum: HS 8

Hauptvortrag MP 12.1 Do 14:00 HS 8

Spontaneous supersymmetry breaking on the lattice — •Urs Wenger — Albert Einstein Center for Fundamental Physics, Institute for Theoretical Physics, University of Bern, Sidlerstrasse 5, CH-3012 Bern, Switzerland

We discuss various strategies for regularising supersymmetric quantum field theories on a space-time lattice. In general, simulations of lattice models with spontaneously broken supersymmetry suffer from a fermion sign problem related to the vanishing of the Witten index. We discuss a novel approach which evades this problem in low dimensions by formulating the path integral on the lattice in terms of fermion loops. Then we present exact results on the spectrum and the Witten index for N=2 supersymmetric quantum mechanics and results from simulations of the spontaneously broken N=1 Wess-Zumino model.

MP 13: Gitterfeldtheorie 2

Zeit: Donnerstag 14:45–16:00 Raum: HS 8

MP 13.1 Do 14:45 HS 8

Costratified Hilbert space structure for lattice gauge models — •Matthias Schmidt — Universität Leipzig, Institut für Theoretische Physik, Brüderstr. 16

The reduced phase space of a system with symmetries, like e.g. gauge theory, is stratified by orbit types. To examine hypothetical quantum effects of the stratification, one has to construct the associated costratification of the Hilbert space of the corresponding quantum theory, proposed by Huebschmann. The method will be explained for the adjoint quotient of SU(2), which can be interpreted as SU(2)-lattice gauge theory on a single plaquette, and attempts to generalize it to larger lattices and larger gauge groups will be discussed.

MP 13.2 Do 15:10 HS 8

Information loss along the renormalization flow — •Cedric Beny and Tobias Osborne — Leibniz Universität Hannover

Our ability to probe the real world is always limited by experimental constraints such as the precision of our instruments. It is remarkable that the resulting imperfect data nevertheless contains regularities which can be understood in terms of effective laws.

The renormalization group (RG) aims to formalize the relationship between effective theories summarizing the behaviour of a single system probed at different length scales. An important feature of the RG is its tendency to converge to few universal effective field theories at large scale.

We explicitly model the change of resolution at which a quantum lattice system is probed as a completely positive semigroup on density operators, i.e., a family of quantum channels, and derive from it a renormalization "group" on effective theories. This formalism suggests a family of finite distinguishability metrics which contract under the RG, hence identifying the information that is lost on the way to universal RG fixed points.

MP 13.3 Do 15:35 HS 8

Elementary (quasi)particles with braided statistics — •Pieter Naaijkens — Leibniz Universität Hannover, Deutschland

Quantum mechanical systems with (quasi)particles or excitations that have braided (or anyonic) statistics (as opposed to the usual Bose/Fermi alternative) have received a lot of attention in recent years. Such (quasi)particles are also called anyons. In this talk we will discuss how these excitations and their properties can be obtained from first priciples. The focus will be on models defined on a plane, for example Kitaev's toric code. The latter can be interpreted as a lattice gauge theory with local $\mathbb{Z}_2 \times \mathbb{Z}_2$ gauge symmetry. Starting from the algebra of observables of this model, given in a ground state representation, all properties of the anyons in this system (such as braiding and fusion) can be recovered. The results match with one expects from known properties of the model when defined on a torus.

We will also comment on recent work, relating the number of equivalence classes of such (quasi)particles to the Kosaki-Longo (or Jones) index of certain inclusions of observable algebras.

MP 14: Poster 2

Zeit: Donnerstag 8:00–18:00 Raum: Poster OG

MP 14.1 Do 8:00 Poster OG

N=1 Supersymmetric Yang-Mills Theory on the Lattice — Georg Bergner[1], Istvan Montvay[2], Gernot Münster[3], •Umut D. Özugurel[3], Stefano Piemonte[3], and Dirk Sandbrink[3] — [1]ITP GU Frankfurt — [2]DESY Hamburg — [3]ITP WWU Münster

N=1 supersymmetric Yang-Mills theory describes the interactions between gluons and their superpartners, spin 1/2 gluinos. The spectrum of the theory consists of many composite particles, such as glueballs, mesons and mixed gluinos and gluons. In a supersymmetric model, particles which belong to the same supermultiplet must have the same mass. In order to show this feature, we study the theory with non-perturbative methods, by discretizing spacetime on an hypercubic lattice and introducing a small gluino mass. This leads to a breaking of supersymmetry, but allows us to study the theory on a computer with Monte Carlo simulations. Supersymmetry is expected to be recovered in the continuum limit and with a vanishing gluino mass. We report that 2 types of mesons and a spin 1/2 gluino-glueball are found as expected to have approximately the same mass and we discuss possible sources of deviation from exact supersymmetry. We also describe some numerical techniques that we developed and used.

MP 14.2 Do 8:00 Poster OG

Practice-oriented Examples for Eigenmode Computation Using Perturbative Methods — •Korinna Brackebusch and Ursula van Rienen — University of Rostock, Rostock, Germany

Parametric studies of geometric variations are an essential part of the performance optimization and error estimation in the design of accelerator cavities. Using common eigenmode solvers the analysis of intentional and undesired geometric perturbations tend to be very extensive since any geometric variation involves an entire eigenmode recomputation. Perturbative methods constitute an efficient alternative for the computation of a multitude of moderately varying geometries. Their practicability was proven by means of simple cavity geometries.

In this paper we investigate the applicability and efficiency for practice-oriented cavity structures. For this, basic geometric parameters of the cavity are varied and the respective eigenmodes are com-

puted by using perturbative as well as common methods. The accuracy of the results and the computational effort of the different methods are compared.

Work supported by Federal Ministry for Research and Education BMBF under contracts 05H09HR5 and 05K10HRC.