T 22: Quantenfeldtheorie II

Zeit: Freitag 14:00–16:30 Raum: KGI-HS 1016

T 22.1 Fr 14:00 KGI-HS 1016

Confinement in Polyakov Gauge — •Florian Marhauser and Jan Martin Pawlowski — Institut für Theoretische Physik, Universität Heidelberg, Philosophenweg 16, D-69120 Heidelberg

The Polyakov loop is the order parameter for confinement. We compute its effective action and thereby the critical temperature using functional renormalization group methods. For $SU(2)$ Yang-Mills theory we observe a second order phase transition and a critical temperature compatible with lattice gauge theory results. Extensions of the calculation are discussed.

T 22.2 Fr 14:15 KGI-HS 1016

Higgs mechanism in five dimensional gauge theories — •Magdalena Luz[1], Francesco Knechtli[2], and Nikos Irges[3] — [1]Bergische Universitaet Wuppertal, Wuppertal — [2]Bergische Universitaet Wuppertal, Wuppertal — [3]University of Crete, Heraklion, Greece

In Gauge-Higgs unification models the Higgs arises from extra-dimensional components of a gauge field in higher dimensions. The extra-dimensions are subject to non trivial (orbifold) boundary conditions which break the full symmetry down to a subgroup, which then is supposed to become the electroweak sector of the standard model. This subgroup can then break again spontaneously through the Hosotani mechanism, leading to massive gauge particles in an effective 4 d theory.

Standard perturbative arguments show no spontaneous symmetry breaking unless (a large number of) fermions are added to the system. However in a non-perturbative lattice study of the pure gauge theory we observed massive gauge particles.

Extra dimensional theories are both non-renormalizable and trivial. The lattice automatically provides a finite cutoff, such it can be probed away from the trivial limit. Recently we have shown that the perturbative calculation also shows SSB if a finite cutoff is left in place.

Our future goal is to investigate whether, despite the non renormalizability, there exists a regime where the physics depends only weakly on the cutoff such that trustable predictions can be made.

T 22.3 Fr 14:30 KGI-HS 1016

Integrating out the Dirac sea: Effective field theory approach to exactly solvable four-fermion models — •Felix Karbstein and Michael Thies — Institut für Theoretische Physik III, Universität Erlangen-Nürnberg, D-91058 Erlangen

We use 1+1 dimensional large N Gross-Neveu models as a laboratory to derive microscopically effective Lagrangians for positive energy fermions only. When applied to baryons, the Euler-Lagrange equation for these effective theories assumes the form of a non-linear Dirac equation. Its solution reproduces the full semi-classical results including the Dirac sea to any desired accuracy. Dynamical effects from the Dirac sea are encoded in higher order derivative terms and multi-fermion interactions with perturbatively calculable, finite coefficients. Characteristic differences between models with discrete and continuous chiral symmetry are observed and clarified.

T 22.4 Fr 14:45 KGI-HS 1016

Das Schmelzen des Soliton-Kristalls im NJL_2-Modell — •Ulf Fritsch und Michael Thies — Institut für Theoretische Physik III, FAU Erlangen-Nürnberg, Staudtstraße 7, D-91058 Erlangen,

Wir präsentieren einen quasi-analytischen Zugang zur Bestimmung einer perturbativen Instabilität bezüglich Kristallbildung im Phasendiagramm des 1+1-dimensionalen Nambu-Jona-Lasinio-Modells für Fermionen mit endlicher intrinsischer Masse. Beim Überschreiten dieser Instabilitätsgrenze zweiter Ordnung wird die Translationssymmetrie wieder hergestellt, der Kristall beginnt zu schmelzen. Für große Dichte sind wir darüberhinaus in der Lage, eine vollständig analytische Vorhersage über den Verlauf dieser Phasenfläche zu ermitteln: Die Abhängigkeit von der Dichte verschwindet, wobei sich ein exponentielles Abklingen der kritischen Grenztemperatur mit anwachsender renormierter Fermionenmasse ergibt. Wendet man das Verfahren auf das seit 2005 bekannte Phasendiagramm des massiven Gross-Neveu-Modells an, so lassen sich die Ergebnisse einwandfrei reproduzieren.

T 22.5 Fr 15:00 KGI-HS 1016

Worldline approach to the Gross-Neveu model — •Klaus Klingmüller[1], Gerald Dunne[2], Holger Gies[3], and Kurt Langfeld[4] — [1]Institut für Theoretische Physik E, RWTH Aachen, 52056 Aachen — [2]Department of Physics, University of Connecticut, Storrs, CT 06269-3046, USA — [3]Institut für Theoretische Physik, Universität Heidelberg, 69120 Heidelberg — [4]School of Maths & Stats, University of Plymouth, Plymouth, PL4 8AA, England

The Gross-Neveu (GN) model is a simple fermionic theory mimicking aspects of QCD, but without gluons and a four-fermion interaction instead. For D = 2 dimensions, in the limit of an infinite number of fermion flavours, the phase diagram of the GN model is known exactly. Remarkably, it shows a crystalline phase with broken translational symmetry at large chemical potential and small temperature. An intriguing question is, if such phases exist for higher dimensional models and in particular in QCD. To compute fermionic determinants in these models we propose to apply worldline numerics. In this approach, the fermionic determinant is expressed in terms of a pathintegral of a pointlike particle which is then evaluated numerically with Monte Carlo techniques. As a first test, we re-derive various aspects of the analytically known phase diagram of the two dimensional GN model. We discuss the potential of our approach to be extended to higher dimensions.

T 22.6 Fr 15:15 KGI-HS 1016

Casimir effect at finite temperature for open geometries — •Alexej Weber[1], Klaus Klingmuller[2], and Holger Gies[1] — [1]Institut für Theoretische Physik, Universität Heidelberg — [2]Institut für Theoretische Physik E, RWTH Aachen

We show that the temperature dependence of the Casimir force can be significantly larger for open geometries (e.g. perpendicular plates) than for closed geometries (e.g. parallel plates). This effect can be attributed to the fact that the fluctuation spectrum for closed geometries is gapped, inhibiting the thermal excitation of modes at low temperatures. By contrast, open geometries support a thermal excitation of the low-lying modes in the gapless spectrum already at low temperatures. We present numerical as well as analytical results for this nontrivial interplay between geometry and temperature using the worldline approach to quantum field theory.

T 22.7 Fr 15:30 KGI-HS 1016

Quantum mass correction for the twisted kink — •Michael Pawellek — Institut für Theoretische Physik III, Universität Erlangen-Nürnberg, Staudtstr.7, D-91058 Erlangen, Germany

We present an analytic result for the 1-loop quantum mass correction in semiclassical quantization for the ϕ^4 kink on S^1 with antiperiodic boundary conditions without explicit knowledge of the fluctuation spectrum. For this purpose we used the spectral discriminant of the $n = 2$ Lamé equation and the integral representation of spectral zeta functions. Physical implications of the result are discussed.

T 22.8 Fr 15:45 KGI-HS 1016

Light Front Quantization of QED_{1+1} at finite Temperatures — •Stefan Strauss and Michael Beyer — Institut für Physik, Universität Rostock

We consider QED_{1+1} in the non-perturbative regime at finite temperatures. To this end, we utilize Discrete Light Cone Quantization (DLCQ) that is a regularization procedure by confining the physical system into finite box in light-like direction. This way a momentum space lattice is introduced by expanding fock states of fixed kinematical momentum K into free particle states. The system is described by the light cone hamiltonian matrix that can be solved using diagonalization methods.

In a hamiltonian framework we compute the canonical partition function and the corresponding thermodynamical potential for different system sizes L at increasing harmonic resolutions K. The double scaling continuum limit $K, L \to \infty$ is discussed. Therefore we investigate several numerical methods and compare for vanishing (strong) coupling our approaches to the analytical result of the ideal Fermi (Bose) gas. This work is relevant for the treatment of strongly coupled systems at finite temperatures such as the quark gluon plasma recently discovered at RHIC and to be investigated more closely at future CERN experiments.

T 22.9 Fr 16:00 KGI-HS 1016

Effective Field Theory of Gravity: Leading Quantum Gravitational Corrections to Newtons and Coulombs Law — •Sven Faller — Universität Siegen, Theoretische Physik 1

In the last years a lot of papers were published treating general relativity as an effective field theory. We are dealing with general relativity and the combination of general relativity and scalar QED as effective field theories. For effective field theories the quantization is well known therefore we are able to quantize general relativity and the combination of general relativity and scalar QED. The vertex rules can be extracted from the action and the non-analytical contributions to the 1-loop scattering matrix of scalars and charged scalars are calculated in the non-relativistic limit. The non-analytical parts of the scattering amplitudes yield the long range, low energy, leading quantum corrections. From the general relativity as an effective field theory the leading quantum corrections to the Newtonian gravity is constructed. General relativity combined with scalar QED yield the post-Newtonian and quantum corrections to the two-particle non-relativistic scattering matrix potential for charged scalar particles. The difference to other publications is finally discussed.

T 22.10 Fr 16:15 KGI-HS 1016

How an IR softly-singular quark-gluon vertex can solve the eta eta' problem without instantons — •Richard Williams[1], Reinhard Alkofer[2], and Christian Fischer[1] — [1]Schlossgartenstrasse 9, D-64289 Darmstadt, Germany — [2]Institute of Physics, Graz University, Universitaetsplatz 5, A-8010 Graz, Austria

Through the analytic behaviour of the quark-gluon vertex in the infrared, as elucidated from studies of the Dyson-Schwinger equations, we show how recently found self-consistent IR divergences, and their associated collinear divergences, may be applied to the Kogut-Susskind mechanism for U(1) symmetry breaking. Thus, without resort to instantons, we have a dynamical means that can help describe the mass splitting of the eta, eta'