T 25: Gittereichtheorie I

Convenor: Jochen Heitger

Zeit: Montag 16:45–19:05 Raum: HG XIII

T 25.1 Mo 16:45 HG XIII

Lattice QCD at finite temperature using maximally twisted mass fermions — •Lars Zeidlewicz — Institut für Theoretische Physik, Universität Münster

The status of two-flavour simulations investigating the thermal transition of QCD using maximally twisted mass fermions is presented. Especially the determination of the pseudo-critical temperature Tc(a,mpi) and the possible extrapolations to the continuum and chiral limits are discussed.

T 25.2 Mo 17:00 HG XIII

Towards the $N_f = 2$ deconfinement transition temperature with O(a) improved Wilson fermions — •Bastian B. Brandt[1], Owe Philipsen[2], Hartmut Wittig[1], and Lars Zeidlewicz[2] — [1]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Johann-Joachim Becher-Weg 45, 55099 Mainz, Germany — [2]Institut für Theoretische Physik, Wilhelm-Klemm-Str. 9, 48149 Münster, Germany

A lot of effort in lattice simulations over the last years has been spent to observe the QCD deconfinement transition. Most state of the art simulations use so called rooted staggered fermions, controversially discussed in the literature, and/or, despite the ongoing effort, are affected by uncertainties and systematic effects, such as coarse lattices and heavy quarks. Therefore it is important to probe the transition with other fermion actions and improve systematics. Nowadays, first results with nonperturbatively O(a) improved Wilson fermions and twisted mass fermions are available, leaving some of the systematics issues unchanged. I report on an ongoing study of the transition, using two degenerate flavours of nonperturbatively O(a) improved Wilson fermions. We start with $N_t = 12$ lattices, aiming at chiral and continuum limit with very light quarks and lattices, at least up to $N_t = 16$.

T 25.3 Mo 17:15 HG XIII

Effective potential for Polyakov loops from a center symmetric effective theory in three dimensions — •Dominik Smith — Institut für Theoretische Physik, Universität Frankfurt, Max-von-Laue Str. 1, 60438 Frankfurt — Frankfurt International Graduate School for Science (FIGGS), Ruth-Moufang-Str. 1, 60438 Frankfurt — Helmholtz Research School for Quark Matter Studies (H-QM), Max-von-Laue-Str. 1, 60438 Frankfurt

We present lattice simulations of a center symmetric dimensionally reduced effective field theory for SU(2) Yang Mills which employ thermal Wilson lines and three-dimensional magnetic fields as fundamental degrees of freedom. The action is composed of a gauge invariant kinetic term, spatial gauge fields and a potential for the Wilson line which includes a "fuzzy" bag term to generate non-perturbative fluctuations. The effective potential for the Polyakov loop is extracted from the simulations including all modes of the loop as well as for cooled configurations where the hard modes have been averaged out. The former is found to exhibit a non-analytic contribution while the latter can be described by a mean-field like ansatz with quadratic and quartic terms, plus a Vandermonde potential which depends upon the location within the phase diagram.

T 25.4 Mo 17:30 HG XIII

Polyakov loop effective action for thermal lattice QCD with heavy quarks — •Jens Langelage[1] and Owe Philipsen[2] — [1]Fakultaet fuer Physik, Universitaet Bielefeld — [2]Institut fuer Theoretische Physik, Universtitaet Muenster

We derive an effective action for lattice QCD with heavy quarks at finite temperature and density using strong coupling and hopping parameter expansions. This action is formulated in three dimensions and depends solely on the Polyakov loop. After a short derivation, we discuss analytical and numerical solutions to this action and compare the results to those of the full (3+1)-dimensional theory.

T 25.5 Mo 17:45 HG XIII

Dispersion relations in abelian and non-abelian plasmas — •Fritz Kretzschmar — Institut fuer Theoretische Physik, Frankfurt am Main, Hessen

Dispersion Relations as used in plasma physics contain the basis for certain properties commonly used in high energy physics. We will calculate the Dispersion Relations of abelian U(1) plasmas and non-abelian SU(2) plasmas in the weak coupling limit respectively. The calculation is done via the **CPIC** (**C**olored-**P**article-**I**n-**C**ell) code, that is a real-time lattice code. Herein the whole system containing N classical particles and gauge fields that are described at every position via plaquettes is described by the Kogut-Susskind-Hamiltonian:

$$H_L = \frac{1}{2}\sum_i \mathbf{E}^{\mathbf{a}\,\mathbf{2}}_{\mathbf{i},\mathbf{L}} + \frac{\mathbf{1}}{\mathbf{2}}\sum_{\square}\left(\mathbf{N_c} - \Re\mathrm{Tr}\mathbf{U}_{\square}\right) + \frac{\mathbf{1}}{\mathbf{N}_{\mathbf{test},\mathbf{L}}}\sum_{\mathbf{j}}|\mathbf{p}_{\mathbf{j},\mathbf{L}}|. \quad (1)$$

Where **E** describes the chromo electric field on the lattice and **p** is the canonical momentum. Additionally N_{test} denotes the number of test particles, used to gain macroscopic behavior.
We will simulate the hard modes by using the Wong equations
The gauge fields evolve via the Yang-Mills equations:

$$D^a_\mu(x)F^{\mu\nu}_{ab}(x) = j^\nu_b(x). \quad (2)$$

Finally we will compare these results with the **HTL** (**H**ard **T**thermal **L**oop) calculations.

As a final result the calculations will yield values for the Debye Mass and show a difference between the HTL calculation and the numerical simulation.

T 25.6 Mo 18:00 HG XIII

The QCD Field Strength Correlator on the Lattice — •Janine Hütig und Owe Philipsen — ITP, WWU Münster

Der quantenchromodynamische Feldstärkekorrelator stellt eine wichtige Größe zur Berechnung von Quarkonium-Zuständen im Rahmen von effektiven Feldtheorien dar. Auf dem Gitter wurde er bereits mehrfach vermessen und auch für das Kontinuum gibt es perturbative Rechnungen bis zur nächstführenden Ordnung. Allerdings lassen sich diese Ergebnisse nicht direkt miteinander vergleichen, da sie jeweils vom Renormierungsschema abhängen. Um nun das Gitter- zum $\overline{\mathrm{MS}}$-Schema übersetzen zu können, ist eine Rechnung in Gitterstörungstheorie erforderlich. Hier werden diese Rechnung sowie die dabei auftretenden Schwierigkeiten diskutiert.

Gruppenbericht T 25.7 Mo 18:15 HG XIII

A New Approach to the Gluon Structure Function — •Daniel Grünewald[1,2], Hans-Jürgen Pirner[1], and Ernst-Michael Ilgenfritz[3] — [1]Institut für theoretische Physik, Universität Heidelberg — [2]Fraunhofer ITWM, Kaiserslautern — [3]Institut für Physik, Humboldt-Universität zu Berlin

We calculate the gluon structure function of a color dipole in a new approach evaluating the matrix element of gluon field operators separated along a direction close to the light cone. As vacuum state in the pure glue sector, we use a variational ground state of the near-light-cone Hamiltonian. With a mean momentum fraction of the gluons fixed to the "experimental value" in a proton, the resulting gluon structure function for a dipole state with four links is rather close to the NLO *MRST* 2002 and the *CTEQAB-0* parameterizations at $Q^2 = 1.5\,\mathrm{GeV}^2$.

T 25.8 Mo 18:35 HG XIII

SU(2) in 2+1 dimensions: twisted boundary conditions, deconfinement, and universality — •Sam Edwards and Lorenz von Smekal — Institut für Kernphysik, TU Darmstadt, Deutschland

In pure SU(N) gauge theory, 't Hooft's twisted boundary conditions fix the number of center vortices of various orientations in a finite box. The free energy of spacelike vortices is then an order parameter for the deconfinement transition. Here we study SU(2) on the lattice in 2+1 dimensions, which is in the universality class of the 2d Ising model. This places a wealth of exact results at our fingertips. In particular, spacelike center vortices in SU(2) at criticality correspond to spin interfaces in the 2d Ising model, whose universal scaling functions are known analytically. By exploiting the exact value of the free energy at criticality, we are able to locate the deconfinement transition in SU(2) with unprecedented precision. Knowledge of the critical lattice couplings then allows for a finite size scaling analysis, where the self-duality of the 2d Ising model is reflected in a duality between the spacelike vortices and confining electric fluxes.

T 25.9 Mo 18:50 HG XIII

Confinement and infrared propagators in lattice Landau gauge — Axel Maas[1], Jan Martin Pawlowski[2,3], •Daniel Spielmann[2,3], Ion-Olimpiu Stamatescu[2], André Sternbeck[4], and Lorenz von Smekal[5] — [1]Institut für Physik, Universität Graz — [2]Institut für Theoretische Physik, Universität Heidelberg — [3]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — [4]Institut für Theoretische Physik, Universität Regensburg — [5]Institut für Kernphysik, Technische Universität Darmstadt

The mechanism of confinement in QCD can be extracted from the infrared behavior of the Landau gauge ghost and gluon propagators. Functional continuum methods find a one-parameter family of solutions, which may be related to the resolution of the Gribov ambiguity of the chosen gauge copy on the lattice.

We investigate SU(2) Yang-Mills theory on the lattice in two, three and four dimensions. In the strong-coupling limit, we find a huge effect of the Gribov ambiguity. We also study stochastic gauge fixing as an alternative to standard gauge fixing methods.