T 26: Gittereichtheorie II

Convenor: Jochen Heitger

Zeit: Dienstag 16:45–19:00 Raum: HG XIII

T 26.1 Di 16:45 HG XIII

Hypercubic-symmetry breaking from minimally doubled fermion actions — •Johannes Weber, Hartmut Wittig, and Stefano Capitani — Institut für Kernphysik, Johannes Gutenberg Universität Mainz, Deutschland

The naively discretised Dirac operator exhibits multiple zero modes distributed across the Brillouin zone. Their number must be reduced in order to identify them with the fermionic degrees of freedom of QCD.

Minimal doubling of lattice fermions requires the introduction of an explicit hypercubic-symmetry-breaking scale. Two prominent examples are Borici-Creutz and Karsten-Wilczek fermions.

These approaches affect the renormalisation properties of fermionic observables as well as the renormalisation properties of the QCD vacuum.

An analysis of the structure of the one-loop renormalisation at the quark level is used to conjecture the properties of hadronic correlation functions.

T 26.2 Di 17:00 HG XIII

Lattice Perturbation Theory with Fermions in the Schrödinger Functional — •Dirk Hesse[1], Georg von Hippel[1,2], and Rainer Sommer[1] — [1]NIC, DESY, Zeuthen — [2]Institut für Kernphysik, Universität Mainz

We present an algorithm to automatically compute Feynman diagrams for lattice perturbation theory with fermions in the Schrödinger functional with a trivial or abelian background field. The flexibility of the algorithm allows for the automation of perturbative calculations independent of the lattice action used.

T 26.3 Di 17:15 HG XIII

Fermion-Determinante in Gitter-QCD — •Björn Leder — Bergische Universität Wuppertal

Die Hybrid-Monte-Carlo Methode ist der Standardalgorithmus zur Behandlung der Fermion-Determinante in Gitter-QCD bei der Erzeugung statistisch unabhängiger Eichfeldkonfigurationen. Seine große Stärke ist gleichzeitig seine Schwäche: Er integriert die Bewegungsgleichungen eines fiktiven klassischen statistischen Systems und erzeugt somit eine Trajektorie im Konfiguationsraum. Dies ändert die Eichfelder im gesamten vier-dimensionalen Volumen. Aber die Änderung ist immer lokal. Große Sprünge im Konfiguationsraum sind nicht möglich. Dies führt zu großen Autokorrelationszeiten für bestimmte Größen und bringt eine systematische Unsicherheit der Ergebnisse mit sich.

Wir betrachten eine alternative Strategie, die im Prinzip beliebig Sprünge im Konfiguationsraum erlaubt. Dabei wird die Fermion-Determiante, oder Verhältnisse solcher, faktorisiert. Die Faktorisierung wird durch exakte oder in-exakte Deflation von Eigenwerten erreicht. Werden genügend Eigenwerte auf diese Weise behandelt steigt die statistische Effizienz auf realistische Werte. Wir untersuchen für verschiedene Faktorisierungen und verschiedene Änderungen des Eichfeldes die numerischen Kosten und Machbarkeit dieser Methode.

T 26.4 Di 17:30 HG XIII

Skalierungseigenschaften geschmierter Wirkungen — •Thorsten Kurth — Bergische Universität, Wuppertal, Deutschland

Es werden die Skalierungseigenschaften zweier Wirkungen mit 6-Stout und 2-HEX geschmierten Links untersucht. In Nf=3 dynamischen Simulationen wird dazu das Spektrum bestimmt. Desweiteren betrachten wir die Skalierung der renormierten Strange-Quark Masse auf gequenchten Konfigurationen und vergleichen mit Resultaten aus der Literatur.

T 26.5 Di 17:45 HG XIII

Charm current-current correlators in twisted mass lattice QCD — •Marcus Petschlies — Institut für Physik, Humboldt-Universität zu Berlin

The charm quark mass and the strong coupling constant are two of the fundamental parameters of the Standard Model and the precision of their determination has been continuously enhanced by higher order perturbative QCD calculations combined with more precise experimental data from $e^+ - e^-$−scattering as well as non-perturbative lattice calculations. As opposed to using experimental data to include non-perturbative effects, lattice QCD is not confined to the vector current correlator alone but additionally allows for an extension to the axial vector, scalar and pseudoscalar current correlators giving rise to a larger number of operators to extract the desired parameters from.

We study the moments of the diverse charm current-current correlators in the framework of twisted mass lattice QCD with two light dynamical quarks. By matching lattice QCD results to continuum perturbation theory the strong coupling constant and the charm quark mass are extracted and compared to QCD sum rule and previous lattice calculations. The talk will be given on behalf of the European Twisted Mass Collaboration.

T 26.6 Di 18:00 HG XIII

Lattice Investigations of Baryon Structure at Light Quark Masses — •Frank Winter — University of Regensburg, Regensburg, Germany

With simulations with dynamical fermions approaching the physical light quark mass we start to get improved control over the approach to the chiral limit. In this talk we will report on recent results from the QCDSF collaboration on the investigation of baryon structure.

We will focus on results for the axial charge of the nucleon for $N_f = 2$ degenerate flavours of Clover fermions. Here first results are available for pion masses reaching as low as 170 MeV. A comparison can be made with results from effective theories.

Furthermore, we will report on initial results for the axial coupling of Hyperons. Here we use configurations with $N_f = 2 + 1$ dynamical favours of SLiNC fermions. With the strange quark mass as an additional dynamical degree of freedom in our simulations we avoid the need for a partially quenched approximation when investigating the properties of particles like the Hyperons, where the quark masses are far from being degenerate.

T 26.7 Di 18:15 HG XIII

The form factors of the nucleon in a finite simulation volume — •Ludwig Greil, Thomas R. Hemmert, and Andreas Schäfer — Institut für Theoretische Physik, Universität Regensburg

Lattice QCD simulations for the form factors of the nucleon have now reached the regime of light quark masses. Surprisingly, the observed trend of the lattice data does not uniformly point towards the known values at the physical point (see e.g. ref.[1]). However, within the framework of baryon chiral perturbation theory (ChPT) the non-linear quark-mass dependence in these observables near the physical point is believed to be well understood [2].

It is our hypothesis that corrections from the finite simulation volume, which have not been taken into account systematically e.g. in the analysis of ref.[1], may be responsible for the observed behaviour of the lattice data. In this talk we present first results of an ongoing finite volume study [3] for the form factors of the nucleon. The goal is to calculate the finite volume corrections to next-to-leading one-loop order in ChPT for the case of 2 light quark flavors. In particular, we present new results for the quark-mass dependence of the magnetic moments of the nucleon as a function of the box length L.

This work has been supported by BMBF and DFG.

References:

[1] e.g. S.N. Syritsyn et al., preprint no. [arXiv, 0907.4194].
[2] e.g. M. Göckeler et al., Phys. Rev. D71, 034508 (2005).
[3] L. Greil, T.R. Hemmert and A. Schäfer, in preparation.

T 26.8 Di 18:30 HG XIII

Non perturbative analysis of the Higgs boson from a chiral invariant lattice Higgs-Yukawa model — •Jim Kallarackal[1,2], Philipp Gerhold[1,2], and Karl Jansen[2] — [1]Humboldt Universitaet zu Berlin, Newstonstr. 15, 12489 Berlin — [2]DESY Zeuthen, Platanenallee, 15738 Zeuthen

The focus of our work is the the non perturbative analysis of the Higgs boson on a discretized space time lattice. Our work makes use of the Neuberger overlap operator which satisfies an exact chiral symmetry on the lattice. Former studies on the lattice Higgs model involving

fermions were lacking a consistent formulation of the chiral symmetry on the lattice. The systematic treatment of the Higgs-Yukawa model enables us to address phenomenological questions of the standard model Higgs sector such as triviality, mass bounds and decay parameters. Our framework enables us to investigate the unstable nature of the Higgs boson and compute its resonance mass as well as its decay width.

T 26.9 Di 18:45 HG XIII

Efficiently utilizing GPUs for Lattice QCD — •Matthias Bach[1,2], Olaf Kaczmarek[3], Wolfang Söldner[4], Christian Schmidt[3], and Piotr Bialas[5] — [1]Frankfurt Institute for Advanced Studies — [2]Institut für Informatik, Frankfurt — [3]Universität Bielefeld — [4]GSI — [5]Jagellonian University, Krakow

Today traditional computer architectures can no longer achieve a speed up by means of higher clock speeds. Many core architectures however show a way to further increase computing power by increasing the number of floating point units on one chip, today over 100 on a single piece of silicon. A particularly cost efficient implementation of these many core architectures are GPUs, providing 1 to 2 TFlops on a single chip at a consumer level price.

The programming model on these many core architectures differs significantly from traditional architectures, especially from custom architectures like the apeNEXT. The huge difference in single and double precision performance and the different characteristics in the ratio of computational power to memory and communication bandwidth require major rethinking of the existing codes.

We have successfully implemented a NVIDIA CUDA based CG solver for calculations with a staggered Dirac operator and are actively working on solving the challenge of efficient multi node calculations and efficient CPU-GPU-cooperation.