HK 21: Theorie

Zeit: Dienstag 8:30–10:30 Raum: 2F

Gruppenbericht HK 21.1 Di 8:30 2F

The structure of the nucleon from lattice QCD simulations — •Philipp Hägler for the QCDSF-UKQCD and LHPC-Collaboration — Institut für Theoretische Physik T39, Physik-Department der TU München, D-85747 Garching

Generalized and transverse momentum dependent parton distribution functions encode a wealth of information about the internal structure of hadrons. They provide direct access to correlations of spin, momentum and coordinate degrees of freedom, and in particular the orbital angular momentum and the spatial distribution of quarks in the nucleon. In this talk, I give an overview of recent lattice QCD results for these observables, based on simulations performed by the QCDSF/UKQCD and LHPC collaborations. Whenever feasible, the lattice results are extrapolated to the physical limit using baryon chiral perturbation theory.

HK 21.2 Di 9:00 2F

Holographic glueball structure — •Hilmar Forkel — ITA, Sao Paulo, Brazil — Institut fuer Theoretische Physik, Uni Heidelberg

We derive and systematically analyze the scalar glueball correlation functions in both the hard-wall and dilaton soft-wall approximations to holographic QCD. We find the nonperturbative physics described by the hard- and soft-wall correlators to be largely complementary. A detailed comparison with QCD results then allows us to obtain holographic estimates for the three lowest-dimensional gluon condensates, the two leading moments of the instanton size distribution in the QCD vacuum, and an effective UV gluon mass. We further obtain the first holographic estimates for the decay constants of the scalar glueball and its excitations. The hard-wall background turns out to encode more of the relevant QCD physics, and its prediction f = 0.8 - 0.9 GeV for the phenomenologically important ground state decay constant agrees inside errors with recent QCD sum rule and lattice results.

HK 21.3 Di 9:15 2F

A non-perturbative approach to the nucleon distribution amplitude — Meinulf Göckeler[1], Roger Horsley[2], •Thomas Kaltenbrunner[1], Yoshifumi Nakamura[3], Dirk Pleiter[3], Paul Rakow[4], Andreas Schäfer[1], Gerrit Schierholz[3,5], Hinnerk Stüben[6], Nikolaus Warkentin[1], and James Zanotti[2] — [1]Institut für Theoretische Physik, Universität Regensburg, 93040 Regensburg, Germany — [2]School of Physics, University of Edinburgh, Edinburgh EH9 3JZ, UK — [3]John von Neumann Institute NIC/DESY Zeuthen, 15738 Zeuthen, Germany — [4]Theoretical Physics Division, Department of Mathematical Sciences, University of Liverpool, Liverpool L69 3BX, UK — [5]Deutsches Elektronen-Synchrotron DESY, 22603 Hamburg, Germany — [6]Konrad-Zuse-Zentrum für Informationstechnik Berlin, 14195 Berlin, Germany

High luminosity accelerators have greatly increased the interest in semi-exclusive and exclusive reactions involving nucleons. The relevant theoretical information is contained in the nucleon wavefunction and can be parametrized by moments of the nucleon distribution amplitude, which in turn are linked to matrix elements of three-quark operators. These can be calculated from first principles in lattice QCD. We present renormalized non-perturbative results for the nucleon distribution amplitude based on its lowest moments and give an outlook on its phenomenological implications.

HK 21.4 Di 9:30 2F

Partonic off-shell effects and the Drell-Yan process — •Fabian Eichstaedt, Stefan Leupold, and Ulrich Mosel — Institut für Theoretische Physik, Universität Gießen

Lepton pair production in the Drell-Yan process can be described by leading order perturbative QCD, however with limitations. The dependence of the differential cross section on the mass of the lepton pair and on the rapidity can only be reproduced with the help of a K-factor and the p_T-spectrum of the lepton pair is not accessible in this way. In fact every finite order pQCD calculation leads to a p_T-spectrum which is divergent at $p_T \to 0$. Therefore we propose a phenomenological approach which incorporates off-shell quarks and show that we can account for the shortcomings of the pQCD description in this model. Work supported by DFG through the European Graduate School "Complex Systems of Hadrons and Nuclei".

HK 21.5 Di 9:45 2F

Spectral properties of the staggered SU(2) Dirac operator — Falk Bruckmann[1], Stefan Keppeler[2], •Marco Panero[1], and Tilo Wettig[1] — [1]University of Regensburg, 93040 Regensburg, Germany — [2]University of Tübingen, 72076 Tübingen, Germany

We study the spectrum of the lattice Dirac operator in the staggered formulation, comparing it with the random matrix theory predictions. For SU(2) gauge group or fermions in the adjoint representation, the antiunitary symmetries of the staggered operator are different from those of the continuum, entailing a description in terms of a different random matrix ensemble. Close to the free limit, the eigenvalues cluster around the values corresponding to the free model, with fluctuations characterized by the Poisson distribution, as predicted by the theory. In this regime, we find a way to accurately describe the observed Dirac spectrum, in terms of the average Polyakov loops in each configuration.

HK 21.6 Di 10:00 2F

Chiral extrapolations of nucleon form factors — •Tobias Gail und Thomas Hemmert — Institut für Theoretische Physik T39, Physik-Department der TU München

We present a calculation of the isovector and isoscalar form factors of the nucleon utilizing the methods of covariant Chiral Perturbation Theory at next-to-leading one-loop order and a consistent renormalization program. We discuss the quark-mass dependence of the anomalous magnetic moments and the radii as well as the full momentum-transfer and quark-mass dependence of the form factors. Furthermore, real chiral extrapolations of lattice results for these observables are performed, i.e. we give predictions for those observables from the combined lattice plus ChPT approach including an analysis of systematic and statistical errors.

HK 21.7 Di 10:15 2F

QCD on the Cell Broadband Engine — •Nils Meyer for the QPACE-Collaboration — Department of Physics, University of Regensburg, 93040 Regensburg, Germany

We evaluate IBM's Enhanced Cell Broadband Engine (BE) as a possible building block of a new generation of lattice QCD machines. The Enhanced Cell BE will provide full support of double precision floating-point arithmetics, including IEEE-compliant rounding. We have developed a performance model and applied it to relevant lattice QCD kernels. The performance estimates are supported by micro- and application-benchmarks that have been obtained on currently available Cell BE-based computers, such as IBM QS20 blades and PlayStation 3. The results are encouraging and show that this processor is an interesting option for lattice QCD applications. For a massively parallel machine on the basis of the Cell BE, an application-optimized network needs to be developed.