HK 14: Hadron Structure and Spectroscopy II

Time: Monday 16:30–19:00 — Location: H-ZO 30

Invited Group Report — HK 14.1 — Mo 16:30 — H-ZO 30
Hadron physics from lattice QCD — •Christine Davies — Dept of Physics and Astronomy, University of Glasgow, Glasgow, UK

I will review recent results from lattice QCD with a particular focus on accurate heavy hadron spectroscopy and the determination of quark masses.

I will also discuss what lattice QCD calculations will able to do in future.

Group Report — HK 14.2 — Mo 17:00 — H-ZO 30
Hadron structure in lattice QCD and ChPT — •Philipp Hägler — Institut für Theoretische Physik T39, Physik-Department der TU München, James-Franck-Strasse, D-85747 Garching

This talk summarizes recent results from hadron structure calculations in lattice QCD. Substantial progress has been made in particular with respect to nucleon form factors and moments of (generalized) parton distributions. These observables allow us to investigate a number of fundamental physics questions related to, e.g., the distribution of charge and momentum in hadrons and their internal spin structure. Results from chiral perturbation theory required for the extrapolation of the lattice data to the physical point will be briefly discussed and applied to selected hadron structure observables.

HK 14.3 — Mo 17:30 — H-ZO 30
Lorentz-Invarianz-Relationen zwischen Partonverteilungen und Wandzura-Wilczek-Näherung — Andreas Metz[1], Peter Schweitzer[2] und •Tobias Teckentrup[3] — [1]Temple University, Philadelphia, USA — [2]University of Connecticut, Storrs, USA — [3]Institut für Theoretische Physik II, Ruhr-Universität Bochum, Deutschland

Partonverteilungen (PDFs), welche von höherem Twist und/oder abhängig vom Transversalimpuls $\mathbf{p}_T$ sind, enthalten wichtige Informationen über die partonische Struktur des Nukleons. Diese Informationen sind ergänzend zu denen, die in den gewöhnlichen Twist-2 PDFs enthalten sind. Die sogenannten Lorentz-Invarianz-Relationen (LIRs) stellen einen Zusammenhang zwischen gewöhnlichen Twist-3 PDFs und Momenten von $\mathbf{p}_T$-abhängigen PDFs her. Die LIRs können somit genutzt werden, um z. B. unbekannte durch besser bekannte PDFs auszudrücken. Es ist jedoch modellunabhängig gezeigt worden, dass die LIRs verletzt sind.

Betrachtet man die LIRs jedoch nun modellunabhängig in der Wandzura-Wilczek-Näherung, d. h. wenn man sowohl Quark-Gluon-Quark-Korrelatoren als auch Stromquark-Massen-Terme vernachlässigt, so kann gezeigt werden, dass die LIRs nicht verletzt sind. Dieses ist ein Hinweis darauf, dass die Verletzung der LIRs vermutlich numerisch klein ist und in bestimmten Fällen sogar vernachlässigt werden kann.

Diese Arbeit wird teilweise durch das BMBF und T. T. durch das Cusanuswerk gefördert.

HK 14.4 — Mo 17:45 — H-ZO 30
Partonic pole matrix elements for fragmentation — •Stephan Meissner[1] and Andreas Metz[2] — [1]Institut für Theoretische Physik II, Ruhr-Universität Bochum, Germany — [2]Department of Physics, Temple University, Philadelphia, USA

In the parton picture hard physical processes can conveniently be described in terms of parton distribution functions (PDFs) and fragmentation functions (FFs). While it is sufficient to consider only two-parton correlation functions at leading twist, three-parton correlation functions need to be taken into account at subleading twist.

Of these three-parton correlation functions the partonic pole matrix elements (PPMEs) are of particular interest, as they are connected to single spin asymmetries and universality breaking terms of PDFs and FFs. So far the studies in this field mostly dealt with PPMEs for PDFs, while PPMEs for FFs were only considered within models. We, however, obtained new, model-independent information on PPMEs for FFs. Our results as well as their physical implications will be presented in this talk.

HK 14.5 — Mo 18:00 — H-ZO 30
Transverse Momentum Distributions of Quarks in the Nucleon from Lattice QCD — •Bernhard Musch[1], Philipp Hägler[1], John Negele[2], Andreas Schäfer[3], and Dru Renner[4] — [1]Institut für Theoretische Physik T39, Technische Universität München, D-85747 Garching, Germany — [2]Massachusetts Institute of Technology, Cambridge, MA02139, USA — [3]Universität Regensburg, D-93040 Regensburg, Germany — [4]Deutsches Elektronen-Synchrotron DESY, D-15738 Zeuthen, Germany

Transverse momentum dependent parton distribution functions encode information about the intrinsic motion of quarks inside the nucleon. They are important non-perturbative ingredients for our understanding of, e.g., azimuthal asymmetries in SIDIS. We present first lattice calculations, based on MILC gauge configurations and propagators from LHPC [1]. We employ non-local operators, consisting of spatially separated quark creation and annihilation operators connected by a straight Wilson line, whose renormalization requires the removal of a divergence linear in the lattice cutoff 1/a. In the kinematical range accessible to us, the resulting distributions show a Gaussian behavior with respect to transverse momentum. Moreover, we find that the transverse momentum densities of polarized quarks in a polarized nucleon are deformed, i.e., not axially symmetric.

Supported by the DFG Emmy Noether-program, BMBF, U.S. DOE grant DE-FG02-94ER40818 and the Excellence Cluster Universe.
[1] B. Musch, Ph. Hägler et al, PoS LC2008 053

HK 14.6 — Mo 18:15 — H-ZO 30
Moments of Parton Distribution Functions from Lattice QCD — Marina Dorati[1], •Thomas Hemmert[2], and Andreas Schäfer[2] — [1]Universita degli Studi di Pavia, Italy — [2]Universität Regensburg, Germany

We present results for the first isovector moment <x>_u-d of the unpolarized parton distribution functions at next-to-leading one-loop order in Baryon Chiral Perturbation Theory, extending the work of ref.[1] to the next order. The first isovector moment <Delta x>_u-d of the polarized parton distribution functions is also presented at next-to-leading one-loop order. Both chiral extrapolation functions are then fitted simultaneously to Lattice QCD data from the LHPC, QCDSF and RBC collaborations. The convergence behavior of the chiral series for the conflicting data sets is studied and a critical discussion of the resulting extrapolated values at the physical point is presented.

[1] M. Dorati, T.A. Gail and T.R. Hemmert, Nucl. Phys. A798, 96 (2008)

HK 14.7 — Mo 18:30 — H-ZO 30
Double polarization measurements in π^0 and η photoproduction for the observable E — •Manuela Gottschall for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Nußallee 14-16, D-53115 Bonn

In contrast to the excitation spectrum of an atom, where the spectral lines are easy to disentangle, the excitation spectrum of the nucleon consists of several overlapping resonances. To study and identify the contributing resonances, a partial wave analysis is needed. To get an unambiguous solution, at least 8 well chosen single and double polarization observables are necessary. With the new Crystal-Barrel/TAPS experiment at the electron stretcher accelerator ELSA, it is presently possible to measure double polarization observables with a linearly or circularly polarized beam and a longitudinally polarized butanol target. Because of its nearly 4π angular coverage and its high detection efficiency for photons, the Crystal-Barrel/TAPS setup is very well suited for the study of the neutral meson photoproduction at the nucleon.

In this talk first results of the measurement of the double polarization observable E in the reactions $\overrightarrow{\gamma}\,\overrightarrow{p} \to p\pi^0$ and $\overrightarrow{\gamma}\,\overrightarrow{p} \to p\eta$ will be presented.

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HK 14.8 — Mo 18:45 — H-ZO 30
Polarised Strangeness Photoproduction at CBELSA-TAPS — •Ralf Ewald for the CBELSA/TAPS-Collaboration — Physikalisches Institut, Universität Bonn

Albeit quark models explain the known baryon spectrum reasonably well, they all overpredict the number of states significantly. This is normally called the *missing resonance* problem. A possible solution may be, that these resonances remained undetected in π-induced reac-

tions, but have a sizeable coupling to decay channels with strangeness involved. Therefore associated Kaon-Hyperon photoproduction is investigated at ELSA.

Data were taken using the combined photon spectrometers Crystal Barrel and TAPS and polarised photonbeam with energies up to 2.9 GeV. This setup was well suited to detect multi photon final states and was therefore ideal to measure the reaction channel $\gamma p \rightarrow \Sigma^+ K_s^0 \rightarrow p\pi^0\pi^0\pi^0 \rightarrow p6\gamma$. This talk deals with the present status of my analysis of this reaction and preliminary results for cross sections and the polarisation observables Σ and P.