HK 19 Theorie

Zeit: Montag 14:00–16:00 Raum: TU MA005

Gruppenbericht HK 19.1 Mo 14:00 TU MA005

Baryon properties in the perturbative chiral quark model — •Thomas Gutsche, V. E. Lyubovitskij und Amand Faessler — Institut für Theoretische Physik, Universität Tübingen, D-72076 Tübingen, Germany

We review recent applications of the perturbative chiral quark model (PCQM) to analyze low-energy properties of baryons: meson-nucleon sigma-terms [1], static strange characteristics of the nucleon [2] and the ground state baryon spectrum [3] among others. The PCQM is based on an effective Lagrangian, where baryons are described by relativistic valence quarks and a perturbative cloud of Goldstone bosons as required by chiral symmetry. Analytical expressions for baryon observables are obtained in terms of fundamental parameters of low-energy pion-nucleon physics (weak pion decay constant, axial nucleon coupling constant, strong pion-nucleon form factor) and of only one model parameter (radius of the nucleonic three-quark core).

[1] T. Inoue, V. E. Lyubovitskij, T. Gutsche and A. Faessler, Phys. Rev. C **69** (2004) 035207

[2] V. E. Lyubovitskij, P. Wang, T. Gutsche and A. Faessler, Phys. Rev. C **66** (2002) 055204

[3] T. Inoue, V. E. Lyubovitskij, T. Gutsche and A. Faessler, arXiv:hep-ph/0404051

Gruppenbericht HK 19.2 Mo 14:30 TU MA005

Hadron attenuation by (pre-)hadronic FSI at HERMES and RHIC — •Thomas Falter, Wolfgang Cassing, Kai Gallmeister und Ulrich Mosel — Institut für Theoretische Physik, Universität Giessen, Germany

We investigate the relation between the hadron attenuation in deep inelastic electron-nucleus scattering (DIS) at HERMES and the observed quenching of high p_T-jets in ultra-relativistic heavy-ion collisions at RHIC. Our transport theoretical approach [1,2] allows for a realistic coupled-channel treatment of the final state interactions (FSI) that goes far beyond the usual Glauber approach. The nuclear DIS data provides us with essential information on the space-time picture of the hadronization process which turns out to be important for the interpretation of jet quenching in ultrarelativistic heavy-ion collisions as a signature for the quark-gluon plasma. We find that (pre-)hadronic FSI play the dominant role for the observed hadron attenuation at HERMES while they cannot fully explain the situation at most central heavy-ion collisions at RHIC. Work supported by BMBF.

[1] T. Falter, W. Cassing, K. Gallmeister, and U. Mosel, Phys. Lett. B **594**, 61 (2004); Phys. Rev. C (in press), nucl-th/0406023.

[2] W. Cassing, K. Gallmeister, and C. Greiner, Nucl. Phys. A 735, 277 (2004); K. Gallmeister and W. Cassing, Nucl. Phys. A (in press), hep-ph/0408223.

HK 19.3 Mo 15:00 TU MA005

Deep inelastic lepton nucleus scattering and hadronization — •Daniel Grünewald — Institut für theoretische Physik der Universität Heidelberg Philosophenweg 19, D-69120 Heidelberg, Germany

Semi-inclusive deep inelastic scattering on nuclei is investigated. An absorption model for possible hadron interaction inside the nucleus is derived and employed, based on flavor dependent hadron formation lengths, which are calculated in the framework of the LUND string fragmentation model. Additionally, the rescaling of parton distribution and fragmentation functions in the nuclear medium due to the hypothesis, that a quark in a bound nucleon has access to a larger region of space, are considered in the partial deconfinement model. The model predictions are compared with recent HERMES results for the multiplicity ratios normalized to deuterium on various hadron species and different nuclei. Beside the proton, a good agreement is found. Furthermore, the mass number dependence of the multiplicity ratios is predicted for both nuclear absorption and energy loss mechanism, providing a possible tool in order to disentangle them.

HK 19.4 Mo 15:15 TU MA005

Some consistency conditions in effective field theory with vector mesons — •Matthias Schindler[1], Dalibor Djukanovic[1], Jambul Gegelia[1,2], and Stefan Scherer[1] — [1]Institut für Kernphysik, Johannes Gutenberg-Universität, Mainz, Germany — [2]High Energy Physics Institute, Tbilisi State University, Tbilisi, Georgia

Effective field theories (EFT) are non-renormalizable in the traditional sense. However, in a consistent EFT all ultraviolet divergences must be absorbable in the redefinition of fields, masses, and coupling constants. The renormalization procedure imposes consistency conditions among the parameters of the Lagrangian.

We first consider the effective Lagrangian describing the interaction among ρ mesons, pions, and nucleons. We perform a one-loop order analysis of the nucleon and ρ-meson self-energies as well as the $\rho\rho\rho$ and ρNN vertex functions. Both the universal coupling of the ρ meson as well as the KSRF value of the ρ-meson coupling constant turn out to be consequences of the self-consistency conditions [1].

Next we include the electromagnetic interactions in the EFT. From the construction as the most general Lagrangian the vector mesons have an arbitrary magnetic moment related to a free constant κ. We analyze self-energies as well as three-particle vertex diagrams at the one-loop level. Imposing the consistency conditions we find that the constant κ is equal to the electric charge, $\kappa = e$, and the $\rho^\pm - \rho^0$ mass ratio is given by $M_\pm/M_0 = \sqrt{1 - e^2/g^2}$, where g is the ρ meson coupling constant.

[1] D. Djukanovic, M. R. Schindler, J. Gegelia, G. Japaridze, and S. Scherer, Phys. Rev. Lett. **93**, 122002 (2004).

HK 19.5 Mo 15:30 TU MA005

Hadronic decays of η and η' — •R. Nissler and B. Borasoy — Helmholtz-Institut für Strahlen- und Kernphysik (Theorie), Universität Bonn, Germany

Future experiments at the planned WASA at COSY facility [1] aim for a precision determination of η and η' decay parameters and have stimulated renewed interest in accurate theoretical investigations of such processes. In this context, the isospin-breaking decays of η and η' into three pions play a prominent role since electromagnetic effects are negligible and hence their decay amplitude is directly proportional to the light quark mass difference $m_d - m_u$. Furthermore, the hadronic decays of η and η' provide important information on η-η' mixing.

Employing a unitarized U(3) chiral effective field theory which includes final state interactions in the s- and p-wave amplitudes, we have calculated the decay widths and Dalitz plot parameters of the hadronic decays $\eta \to \pi\pi\pi$, $\eta' \to \pi\pi\pi$ and $\eta' \to \eta\pi\pi$ extending previous work on s-waves [2]. We find p-wave interactions to be important in the decay $\eta' \to \pi^+\pi^-\pi^0$, where phase space is large enough to allow for significant contributions of the $\rho(770)$ resonance.

Financial support of the DFG is gratefully acknowledged.

[1] B. Höistad et al., "Proposal for WASA at COSY", http://www.fz-juelich.de/ikp/wasa/

[2] N. Beisert and B. Borasoy, Nucl. Phys. **A716** (2003) 186.

HK 19.6 Mo 15:45 TU MA005

Study of axial charge of $N(1535)$ in threshold $\eta\pi$ production — •Daisuke Jido[1], Atsushi Hosaka[2], and Makoto Oka[3] — [1]Physik-Department, Technische Universität München,James-Franck-Strasse, D-85747 Garching — [2]Research Center for Nuclear Physics, Osaka University, Ibaraki,Osaka, 567-0047, Japan — [3]Physics Department, Tokyo Institute of Technology, Meguro, Tokyo, 152-8551, Japan

Axial charge is one of the most important static properties of hadrons. Especially a relatively negative sign of a parity partner of nucleon opens a new possibility to form a chiral doublet of nucleon and its parity partner. In the linear realization of chiral symmetry in nucleons, there are two possible ways to assign the chiral multiplets to nucleon and its parity partner depending on the sign of the axial charge of the parity partner. These two assignments are shown to have phenomenologically distinguished predictions. We report on a theoretical study of double meson production reaction of the eta and pi mesons in the threshold region in order to determine the sign of the axial charge of $N(1535)$ (N^*). The eta meson is used as a probe for N^* production in the intermediate state.

The pion emmited in the final state is then used to extract the sign of the axial charge. Calculating cross section of the $\pi^- p \to \pi^- \eta p$ reaction, we find that the most distinct dependence on the sign of N^* is seen in the slope of the angular distribution of the final π^- state as a result of an interference of the p-wave nature of the $\pi N^* N^*$ coupling and the s-wave nature of the $\pi N N^*$ coupling.

[1] D. Jido, M. Oka and A. Hosaka, Prog. Theor. Phys. **106** (2001) 823, 873.

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