HK 24 Elektromagnetische und Hadronische Proben

Zeit: Dienstag 14:00–16:00 Raum: TU MA001

Gruppenbericht HK 24.1 Di 14:00 TU MA001

First observation of in-medium modifications of the omega meson in photonuclear reactions — •David Trnka for the CBELSA/TAPS collaboration — II. Physikalisches Institut, Heinrich-Buff-Ring 16, 35392 Giessen

One of the exciting topics in nuclear physics is the modification of experimentally observable properties of vector mesons such as mass and width, when embedded in a medium. A variety of theoretical models predict a mass shift of the ω-meson in the order of $-140MeV < m^* - m_V < -15MeV$ and a broadening of the width within a range of 20 to 50 MeV at normal nuclear densities (i.e. :[1]). A promising approach is to study the decay $\omega \to \pi^0+\gamma$ in photonuclear reactions. This mode accounts for $9 \cdot 10^{-2}$ of the total width, while for the ρ it is only $6 \cdot 10^{-4}$. Consequently it provides an exclusive probe to study the ω-meson properties in matter. Simulations prove that distortions due to FSI of the pions can be strongly suppressed ([2]) . The experiment was carried out at the ELSA accelerator facility in Bonn using the Crystal Barrel/TAPS detector array. C, Ca, Nb and Pb have been used as targets while the LH2 target was used as a reference measurement. An ω mass shift by about 10 % has been observed in the fully inclusive invariant mass spectra as well as after applying kinematical constraints to suppress rescattered pions. Furthermore, the dependence on the ω-momentum has been studied. Mass changes are only observed for ω-mesons with momenta less than 500 MeV/c.

[1] T. Renk et al. , Phys. Rev. C 66, (2002) 014902
[2] J. G. Messchendorp et al. , Eur. Phys. J. A. 11, 95-103 (2001)

HK 24.2 Di 14:30 TU MA001

Neutron Polarizabilities from Deuteron Compton Scattering — •Robert P. Hildebrandt, Harald W. Griesshammer, and Thomas R. Hemmert — Institute for Theoretical Physics (T39), TU München, Germany

Due to the lack of stable single neutron targets for Compton scattering, experimental access to the neutron polarizabilities is much harder than in the proton case. One possible way to determine the neutron polarizabilities is Compton scattering off the deuteron. Therefore, an accurate description of the Chiral Dynamics inside the deuteron is needed, as one has to correct for the proton polarizabilities and binding effects.

In this work, we extend Chiral Effective Field Theory calculations of Compton scattering off the deuteron by including explicit $\Delta(1232)$ degrees of freedom [1], finding very good agreement with experimental data, including the often discussed SAL-data measured at a photon energy of 95 MeV. We further discuss the well-known problem to recover the correct Thomson-limit in ChEFTs and show how to solve it [2]. This leads us towards a consistent description of deuteron Compton scattering below the pion mass and enables us to perform high-precision fits of the isoscalar nucleon polarizabilities to deuteron Compton data. Work supported in part by DFG and BMBF.

[1] R.P. Hildebrandt, H.W. Grießhammer, T.R. Hemmert, D.R. Phillips, nucl-th/0405077, accepted for publication at Eur. Phys. J. A.

[2] R.P. Hildebrandt, H.W. Grießhammer, T.R. Hemmert, in preparation.

HK 24.3 Di 14:45 TU MA001

Deuteron Electro-Disintegration at Very Low Energies — •Stefan Christlmeier and Harald W. Griesshammer — T39, Technische Universität München, D-85747 Garching

We consider the deuteron break-up ${}^2H(e,e'p)n$ at very low momentum transfer ($q < 100$ MeV) and close to threshold in the low-energy nuclear Effective Field Theory without dynamical pions. The result is model-independent, analytic, simple, manifestly gauge-invariant and does not suffer from ambiguities in treating off-shell effects or meson-exchange currents. There are no free parameters, and the reaction is determined by simple, well-known observables on the 1%-level. Decomposing the doubly differential cross-section into the longitudinal-plus-transverse ($L+T$), transverse-transverse (TT) and longitudinal-transverse interference (LT) terms, we compare to a Bonn-potential calculation by Arenhövel et al. and to experimental findings at S-DALINAC. There is no space on the theory-side for the 30%-discrepancy between theory and experiment in σ_{LT}, with un-determined short-distance contributions that could affect σ_{LT} entering only at very high orders. Further observables with relevance to big-bang nucleo-synthesis are commented upon.

HK 24.4 Di 15:00 TU MA001

Chiral symmetry and resonances in QCD — •Matthias F.M. Lutz[1] and Evgueni E. Kolomeitsev[2] — [1]GSI, Planck Str. 1, D-64289 Darmstadt — [2]The Niels Bohr Institute, Blegdamsvej 17, DK-2100 Copenhagen

We study the formation of resonances in terms of the chiral SU(3) Lagrangian. At leading order parameter-free predictions are obtained for the scattering of Goldstone bosons off any hadron once we insist on approximate crossing symmetry of the unitarized scattering amplitude. A wealth of empirically established resonances are recovered and so far unseen resonances are predicted.

HK 24.5 Di 15:15 TU MA001

Electroproduction of Nucleon Resonances — •Lothar Tiator[1], Dieter Drechsel[1], Sabit Kamalov[2], Mauro M Giannini[3], Elena Santopinto[3] und Andrea Vassallo[3] — [1]Institut für Kernphysik, Universität Mainz — [2]Laboratory of Theoretical Physics, JINR Dubna, 14980 Moscow Region, Russland — [3]Dipartimento di Fisica dell' Universita di Genova and INFN, Sezione di Genova, Genova, Italy

The Mainz unitary isobar model MAID has been extended and used for a partial wave analysis of pion photo- and electroproduction in the resonance region $W < 2$ GeV. Older data from the world data base and more recent experimental results from Mainz, Bates, Bonn and JLab for Q^2 up to 4.0 $(\mathrm{GeV/c})^2$ have been analyzed and the Q^2 dependence of the helicity amplitudes have been extracted for a series of four star resonances. We compare single-Q^2 analyses with a superglobal fit in a new parametrization of Maid2003 together with predictions of the hypercentral constituent quark model. As a result we find that the helicity amplitudes and transition form factors of constituent quark models should be compared with the analysis of bare resonances, where the pion cloud contributions have been subtracted. Finally, we will compare our results with recent lattice QCD calculations for the $N \to \Delta$ transition. The quenched calculations of Alexandrou et al. can describe the E/M and S/M ratios for $Q^2 < 1.5$ GeV^2 reasonably well but overestimate the dominant magnetic G_m^* form factor by nearly a factor of 2 at large Q^2.

HK 24.6 Di 15:30 TU MA001

The Fubini-Furlan-Rosetti Sum Rule — •Barbara Pasquini[1], Dieter Drechsel[2], and Lothar Tiator[2] — [1]Dipartimento di Fisica Nucleare e Teorica, Universita degli Studi di Pavia and INFN, Sezione di Pavia, Pavia, Italy — [2]Institut für Kernphysik, Universität Mainz

The Fubini-Furlan-Rossetti sum rule for pion photoproduction on the nucleon is evaluated by dispersion relations at constant t, and the corrections to the sum rule due to the finite pion mass are calculated. Near threshold these corrections turn out to be large due to pion-loop effects, whereas the sum rule value is closely approached if the dispersion integrals are evaluated for sub-threshold kinematics. This extension to the unphysical region provides a unique framework to determine the low-energy constants of relativistic chiral perturbation theory by global properties of the excitation spectrum. In a further extension of this work the unitary isobar model MAID will be constrained by fixed-t dispersion relations. This will considerably improve the description of the non-resonant background contribution and will directly satisfy the requirements of crossing symmetry.

HK 24.7 Di 15:45 TU MA001

Relativistic treatment of the $N^*(1520)$ and its decay channels — •Lukas Jahnke and Stefan Leupold — Institut für Theoretische Physik, Universität Giessen, Germany

It has turned out that the $N^*(1520)$ is rather important to study in-medium changes of hadronic properties [1]. The analysis of elementary reactions provides here an important ingredient. The presented approach aims at a description of the pion-induced production of dileptons on the nucleon in the $N^*(1520)$ region. A brief introduction to the relativistic treatment of free and interacting spin-3/2 particles is presented paying special attention to the issue of how to maintain the correct number of degrees of freedom [2]. Consistent couplings of the $N^*(1520)$ to pion-nucleon and rho-nucleon are presented. The corresponding self energies

are determined to obtain the full $N^*(1520)$ propagator.

[1] M. Post, S. Leupold and U. Mosel, Nucl. Phys. A 741, 81 (2004)
[2] V. Pascalutsa and R. Timmermans, Phys. Rev. C 60, 042201 (1999)