

HK 73: Hadronenstruktur und -spektroskopie

Zeit: Donnerstag 16:45–19:15

Raum: HSZ-105

Gruppenbericht

HK 73.1 Do 16:45 HSZ-105

Pion photo- and electroproduction in effective field theory — ●MARIUS HILT¹, STEFAN SCHERER¹, LOTHAR TIATOR¹, and JAMBUL GEGELIA² — ¹Institut für Kernphysik, Universität Mainz — ²Institut für Theoretische Physik II, Ruhr-Universität Bochum

We present a calculation of pion photo- and electroproduction on the nucleon in manifestly Lorentz-invariant baryon chiral perturbation theory up to and including chiral order q^4 . With the results we analyze the new $\pi^0 p$ photoproduction data in the threshold region obtained at the Mainz Microtron. In the calculation of observables and the fit of the low-energy constants, we take S, P, and D waves into account. We compare the results for the multipoles with the corresponding single-energy analysis. Furthermore, we also fit the (q^4) heavy baryon chiral perturbation theory calculation and compare both results. In a second approach we include vector mesons as explicit degrees of freedom in one-loop contributions up to order q^3 in order to improve the description for the electroproduction process. We compare this approach and the q^4 calculation with existing data of pion electroproduction in the threshold region. We provide predictions for several polarization observables for future experiments.

HK 73.2 Do 17:15 HSZ-105

Propagator poles and an emergent stable state below threshold: general discussion and the $E(38)$ state — ●THOMAS WOLKANOWSKI and FRANCESCO GIACOSA — Institut für Theoretische Physik, Goethe-Universität Frankfurt, Max-von-Laue-Straße 1, D-60438 Frankfurt, Germany

Employing a simple quantum field-theoretical model which describes the decay of a scalar state into two (pseudo)scalar ones, we investigate the poles of the scalar propagator. Besides the expected resonance pole in the lower half-plane of the second Riemann sheet, we find – for a sufficiently large coupling constant – an additional pole on the first sheet below threshold, corresponding to a dynamically generated stable state. We then perform a numerical study for a hadronic system involving a scalar seed state that couples to pions. It is clarified under which conditions a stable state below the two-pion threshold can emerge. In particular, in reference to the recent claim of a novel scalar boson with mass 38 MeV (termed $E(38)$), we explore the case of a stable state with such a mass. Our findings suggest that the resonance $f_0(500)$ and the stable state $E(38)$ could be interpreted as two different manifestations of one and the same 'object'.

HK 73.3 Do 17:30 HSZ-105

Quasifree Photoproduction of Eta-Pion Pairs off the Deuteron — ●ALEXANDER KAESER for the A2-Collaboration — Departement of Physics, University of Basel, CH-4056 Basel, Switzerland, for the Crystal Ball/TAPS collaboration

The photoproduction of $\eta\pi^0$ and $\eta\pi^\pm$ pairs off the deuteron was investigated at the Mainz Microtron accelerator facility MAMI for photon energies up to 1.5 GeV. The detector setup consisted of the combined Crystal Ball and TAPS electromagnetic calorimeters. Invariant mass distributions for the neutral and charged channels as well as angular distributions for Φ and $\cos(\Theta)$ were extracted from the data. In addition, total cross-sections for both channels have been extracted. The results will be discussed in the context of the contributions of different resonances to the respective reactions.

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HK 73.4 Do 17:45 HSZ-105

Discussion on a complete experiment for single pseudoscalar meson photoproduction — ●YANNICK WUNDERLICH for the CBELSA/TAPS-Collaboration — HISKP University of Bonn

Photoproduction of single pseudoscalar mesons poses a commonly used tool for the study of the nucleon excitation spectrum. In this reaction, the measurement of 16 different polarization observables is possible. The observables comprise a rich volume of accessible experimental information, usable for the disentanglement of the strongly overlapping resonances of the nucleon.

Since the beginning of the 1970s, the problem of the so called complete experiment started to emerge in the literature. It deals with the question which minimum subsets of all 16 polarization observables are

sufficient in order to maximally constrain the underlying amplitudes. This optimization problem is important in the context of currently ongoing polarization measurements at facilities like MAMI, JLAB and ELSA. In the 1990s, it was shown that 8 carefully chosen observables suffice to yield a complete experiment. However, in the low energy region of certain photoproduction channels and in connection to a maximally model independent truncated partial wave analysis, there exists the realistic chance for achieving completeness with even less than 8 observables.

This talk will state and discuss the origin of the above mentioned results. Supported by the Deutsche Forschungsgemeinschaft (SFB/TR~16).

HK 73.5 Do 18:00 HSZ-105

NLO corrections to NN scattering amplitude in modified Weinberg approach — EVGENY EPELBAUM¹ and ●JAMBUL GEGELIA^{1,2} — ¹Institut für Theoretische Physik II, Fakultät für Physik und Astronomie, Ruhr-Universität Bochum 44780 Bochum, Germany — ²Tbilisi State University, 0186 Tbilisi, Georgia

We consider the next-to-leading order corrections to the NN scattering amplitude in modified Weinberg approach. We present the corrections to the partial wave phase shifts. To probe the convergence, for the 1S_0 partial wave by applying the subtractive renormalization we compare the results of perturbative and non-perturbative treatment of the next-to-leading order contact interaction correction to the effective potential.

HK 73.6 Do 18:15 HSZ-105

τ Spectral Functions within a Linear Sigma Model with Electroweak Interactions — ●ANJA HABERSETZER¹, FRANCESCO GIACOSA¹, and DIRK H. RISCHKE^{1,2} — ¹Institut für Theoretische Physik, Goethe-Universität Frankfurt, Max-von-Laue-Straße 1, D-60438 Frankfurt — ²Frankfurt Institute for Advanced Studies (FIAS), Ruth-Moufang-Straße 1, D-60438 Frankfurt

We present the (axial-) vector spectral function for the τ lepton within a Linear Sigma Model with global chiral $U(2)_L \times U(2)_R$ symmetry. The τ decays weakly with intermediate ρ and a_1 meson states. The electroweak interaction was introduced via a $SU(2)_L \times U(1)_Y$ gauge transformation of the hadronic fields and an additional gauge invariant term. The spontaneously broken chiral symmetry leads to a mass difference between the chiral partners ρ and a_1 and is also exhibited in the vector and axial-vector coupling constants. We show the results for the τ spectral function in the vector and axial-vector channel and compare them to the spectral functions as measured by the ALEPH collaboration.

Supported by the Helmholtz Research School for Quark Matter Studies (H-QM) and HGS-HIRE and GSI.

HK 73.7 Do 18:30 HSZ-105

Meson Production in Coherent Antiproton-Nucleus Reactions — ●STEFANIE LOURENCO¹, HORST LENSKE¹ und SLAWOMIR WYCECH² — ¹Institut für Theoretische Physik, Universität Gießen — ²National Centre for Nuclear Studies, Hoza 69, 00-681, Warsaw, Poland

Meson and hadron production by antinucleon-nucleus annihilation reactions is well suited to explore a broad spectrum of final particle configurations and physics phenomena. We are investigating coherent meson production in antiproton-nucleus reactions, intended as exploratory studies for the PANDA experiment and, if realized at a later stage of FAIR, also for the nuclear structure-oriented use of high energy antiprotons aimed for by the AIC proposal. Coherent reactions have the distinct advantage of a full quantum mechanical treatment of all parts of the production process. As a concrete and typical example we treat explicitly the case of two pion production. Two different reaction mechanisms are presented including initial and final state interactions. The underlying fundamental antinucleon-nucleon $\bar{N}N$ and pion-nucleon πN interactions enter into the optical potentials, which are folded with Hartree-Fock-Bogoliubov nuclear densities. Existing approaches to pion nucleus interactions have been extended to higher energies beyond the Δ -resonance. Cross sections are shown for the elementary processes and future experiments at FAIR.

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HK 73.8 Do 18:45 HSZ-105

Two-pion production in the first resonance energy region —
•VITALY SHKLYAR, HORST LENSKE und ULRICH MOSEL — Institut für
Theoretische Physik, Universität Gießen

The $\pi N \rightarrow \pi N$, $2\pi N$ reactions are analyzed within a coupled-channel unitary Lagrangian model. The contributions to $2\pi N$ are described in terms of the isobar production mechanism with σN and $\pi\Delta$ in the intermediate state. The self-energies of the σ -meson and the $\Delta(1232)$ -isobar are taken into account to reproduce a correct energy behavior of resonance decays in the isobar channel. The analysis of the Crystal Ball data on $2\pi^0$ production is presented and discussed.

HK 73.9 Do 19:00 HSZ-105

Photoproduction of Pion-Pairs off Nucleons — •MARKUS
OBERLE for the A2-Collaboration — Departement of Physics, Uni-

versity of Basel, CH-4056 Basel, Switzerland

Photoproduction of meson pairs is an important tool for the investigation of nucleon resonances. At higher excitation energies many nucleon resonances have only small decay branching ratios to the nucleon ground state. They decay preferentially to intermediate excited states. This is similar to nuclear physics, only a very rudimentary picture of nuclear structure would arise when only ground-state transitions were considered. The experimental study of such decays requires the measurement of final states with at least meson pairs. The analysis of such reactions requires the measurement of differential cross sections and polarization observables.

The present experiment measured photoproduction of pion pairs ($\pi^0\pi^0$, $\pi^0\pi^\pm$ final states) off free protons and off quasi-free protons and neutrons bound in the deuteron at the MAMI accelerator in Mainz with the Crystal Ball/TAPS detector. Results for beam-helicity asymmetries and differential cross sections will be discussed and compared to the results from reaction models.