HK 34: Hadron Structure and Spectroscopy I

Time: Tuesday 16:30–19:00 Location: H-ZO 20

Invited Group Report HK 34.1 Tu 16:30 H-ZO 20

Chiral Perturbation Theory and Mesons — •Johan Bijnens — Lund University, Lund, Sweden

I will give a short introduction to and an overview of recent work in Chiral Perturbation Theory for Mesons. I will concentrate on the present status of higher order calculations in this field and possible future directions.

HK 34.2 Tu 17:00 H-ZO 20

Chiral logarithms tamed — Nikolai Kivel[1,2], Maxim Polyakov[1,2], and •Alexei Vladimirov[2,3] — [1]Petersburg Nuclear Physics Institute, Gatchina, St. Petersburg 188350, Russia — [2]Institute for Theoretical Physics II, Ruhr University Bochum, 44780 Bochum, Germany — [3]Bogolubov Laboratory of Theoretical Physics, JINR, 141980 Dubna, Russia

We derive non-linear recursion relations for the leading chiral logarithms (LLs). These relations provide not only very efficient method to compute LLs (e.g. the 33-loop contribution is calculated in dozens of seconds on a PC) but equip us with a powerful tool to sum up the LLs. Our method is not limited to the chiral perturbation theory, it is pertinent for any non-renormalizable effective feld theory such as, for instance, theory of critical phenomena, low-energy quantum gravity, etc.

In the present talk this method would be considered on the example of pion-pion scattering.

HK 34.3 Tu 17:15 H-ZO 20

Neutrino induced pion production at MiniBooNE and K2K within the GiBUU model — •Tina Leitner[1], Oliver Buss[1], Ulrich Mosel[1], and Luis Alvarez Ruso[2] — [1]Institut für Theoretische Physik, Universität Giessen, Germany — [2]Universidad de Murcia, Spain

The interest in neutrino nucleus reactions is driven by the discovery of neutrino oscillations where one now aims at a precise determination of neutrino oscillation parameters. This demands for an equally precise knowledge of the neutrino nucleus interaction process. Neutrino induced pion production is strongly influenced by nuclear effects. Their understanding is crucial since neutral current π^0 production is a major background in ν_e appearance experiments, while charged current π^+ production introduces a background to ν_μ disappearance searches.

We have investigated both, charged and neutral current neutrino induced pion production off nuclei, at MiniBooNE and K2K energies within the GiBUU transport model. Assuming impulse approximation, we treat the nucleus as a local Fermi gas of nucleons bound in a density and momentum potential. The outcome of the initial neutrino nucleon reaction undergoes complex hadronic final state interactions where in-medium spectral functions of the particles are taken into account. We present results for neutral current π^0 and charged current π^+ production and compare to first MiniBooNE and K2K data.
Work supported by DFG.

HK 34.4 Tu 17:30 H-ZO 20

One-pion production in neutrino-induced reactions — •Olga Lalakulich, Oliver Buss, Tina Leitner, and Ulrich Mosel — Institut für Theoretische Physik, Universität Giessen, Germany

We investigate neutrino interactions with nucleons and nuclei, paying special attention to one–pion production reactions. The elementary neutrino–nucleon cross section is presented as the sum of the leading Delta–pole diagram and several background diagrams calculated within the non-linear sigma–model. Neutrino interactions with nuclei are treated within the GiBUU transport model that takes into account various nuclear effects. The results, presented for several final states, are compared to the experimental data from several completed and running neutrino experiments.
Work supported by DFG.

HK 34.5 Tu 17:45 H-ZO 20

Photoproduction of pion pairs off ^{7}Li — •Yasser Maghrbi for the A2-Collaboration — Department of Physics, University of Basel

The photoproduction of $\pi^0\pi^0-$ and $\pi^0\pi^{+/-}-$ pairs off ^{7}Li has been studied at the Mainz MAMI accelerator for photon energies from threshold to 830 MeV. The experiment used the Glasgow photon tagging device and the combined Crystal Ball/TAPS electromagnetic calorimeter. The experiment was motivated by the much discussed in-medium properties of the σ-meson. Previous results indicated a shift of the strenght to small invariant masses for $\pi^0\pi^0$ but not for $\pi^0\pi^{+/-}$. However, comparisons to transport model calculations have shown that final state interaction (FSI) can produce similar effects. Therefore, in a new series of experiments with improved statistical quality, data was also taken for the light nucleus ^{7}Li, serving as a better reference point for FSI. Preliminary total cross sections and invariant mass distributions will be presented.

Supported by Schweizerischer Nationalfond, DFG, and EU/FP6.

HK 34.6 Tu 18:00 H-ZO 20

Radiative pion photoproduction in the region of the Delta(1232) resonance — •Evangeline J Downie for the A2-Collaboration — Institut fuer Kernphysik, Johannes Gutenberg Universitaet, Mainz, Germany

The Delta(1232) is perhaps the best-studied resonance in the nucleon excitation spectrum. From these studies, we have learned much about the nucleon-delta transition. However we have learned very little about the properties of the Delta itself, due to the exceedingly short lifetime of this strongly-decaying resonance. The Magnetic Dipole Moment of the Delta(1232) is predicted by many theories and models, ranging from the chiral limit to Lattice QCD (LQCD) calculations at unphysically high quark mass values. The experimental determination of this quantity in the physical mass region would provide both a strong test of the many models which operate within this region and an important constraint on the extrapolation between theoretical predictions at the chiral and LQCD quark mass limits.

The A2 Collaboration, of the Institut fuer Kernphysik at Johannes Gutenberg Universitaet in Mainz, Germany, are studying this property using radiative pion photo production. The experiment makes use of the tagged photon beam, produced by the Glasgow Photon Tagging Spectrometer from the MAMI electron beam. The reaction products, passing out of the liquid Hydrogen target, are detected using the powerful, large acceptance spectrometer combination of the Crystal Ball and TAPS. The talk will cover the method, data analysis and latest results from this experiment.

HK 34.7 Tu 18:15 H-ZO 20

Analysis of the $\eta \to e^+e^-e^+e^-$ decay — •Leonid Yurev for the WASA-at-COSY-Collaboration — Institut für Kernphysik and Jülich Center for Hadron Physics, Forschungszentrum Jülich, D-52425 — Joint Institute for Nuclear Research, Dzhelepov Laboratory of Nuclear Problems, 141980 Dubna, Russia

The decay $\eta \to e^+e^-e^+e^-$ is closely related to the channels with real photons: $\eta \to \gamma\gamma$, $\eta \to \pi^+\pi^-\gamma$, $\eta \to e^+e^-\gamma$ which are driven by the chiral anomaly of Quantum Chromodynamics. The extended interaction region of the electromagnetic processes of the η meson is parameterized by a so-called *transition form factor* – a scalar function of the invariant masses squared of the photons. The decay $\eta \to e^+e^-e^+e^-$ allows to study the form factor in the domain where there are two virtual photons with positive invariant masses squared.

We have recorded $10^7\eta$ events in the reaction $pd \to {}^3\mathrm{He}\eta$ at 1 GeV during a four weeks run in October 2008. The experimental method is similar to that used recently by the CELSIUS/WASA collaboration where two $\eta \to e^+e^-e^+e^-$ decay candidates were identified and an upper limit $BR(\eta \to e^+e^-e^+e^-) < 9.7 \cdot 10^{-5}$ (90% CL) was determined. Since the number of the η decays collected by the WASA-at-COSY collaboration is forty times larger, we expect to extract a statistically significant data sample of $\eta \to e^+e^-e^+e^-$ decays for the first time. In this presentation the status of the analysis of the $\eta \to e^+e^-e^+e^-$ decay channel and preliminary results will be discussed.

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HK 34.8 Tu 18:30 H-ZO 20

Vector-meson dominance from counting rules — •Stefan Leupold[1] and Matthias Lutz[2] — [1]Institut für Theoretische Physik, Universität Giessen, Germany — [2]Theory Division, GSI, Darmstadt, Germany

Recently a systematic flavour SU(3) framework has been proposed [1] to describe the strong and electromagnetic interactions of light pseudoscalar and vector mesons, with the latter represented by antisymmetric tensor fields. From the corresponding leading-order Lagrangian one can deduce for which processes vector-meson dominance applies and for which it does not. In particular, it turned out that at leading order the hadronic three-body and also the radiative decays of vector mesons are governed by vector-meson dominance. This allows to predict the hadronic three-body decays, once the parameters are determined from the radiative decays [2]. The obtained result for the three-pion decay of the omega meson agrees very well with experiment. The partial decay widths for the rare three-body decays of the K^* are predicted. Further examples are discussed where the leading-order Lagrangian does not lead to vector-meson dominance.

Work of S.L. supported by GSI.

[1] M.F.M. Lutz and S. Leupold, Nucl. Phys. A **813** (2008) 96, arXiv:0801.3821 [nucl-th].

[2] S. Leupold and M.F.M. Lutz, arXiv:0807.4686 [hep-ph].

HK 34.9 Tu 18:45 H-ZO 20

$\eta \to \pi^+\pi^-\pi^0$ decay with WASA-at-COSY — •Patrik Adlarson for the WASA-at-COSY-Collaboration — Department of Physics and Astronomy, Uppsala University, SE-751 21 Uppsala, Sweden

In the fall of 2008 a four week experiment was carried out with WASA-at-COSY with the purpose of studying η- decays. The ηs were produced in the $pd \to {}^3He\,\eta$ reaction at beam kinetic energy 1 GeV and in total approximately 10^7 of such events were collected. This data will be used to study the not so rare η decays involving charged pions, most notably $\eta \to \pi^+\pi^-\pi^0$. This decay proceeds mainly via a strong isospin violating contribution, where the decay width is proportional to the quark mass difference squared, $(m_d - m_u)^2$. Preliminary results of the analysis are presented.

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