

HK 44: Hadronenstruktur und -spektroskopie

Zeit: Dienstag 16:45–19:00

Raum: HSZ-403

Gruppenbericht

HK 44.1 Di 16:45 HSZ-403

A chiral model with (axial-)vector mesons and glueballs: meson and baryon phenomenology — ●FRANCESCO GIACOSA¹, SUSANNA GALLAS¹, DENIS PARGANLIJA^{1,2}, STANISLAUS JANOWSKI¹, ACHIM HEINZ¹, WALAA I. ESHRAIM¹, KHALED TEILAB¹, PETER KOVACS³, GYURI WOLF³, and DIRK H. RISCHKE^{1,4} — ¹Inst. for Theor. Physics, Johann Wolfgang Goethe University, Max-von-Laue-Str. 1, D-60438 Frankfurt am Main, Germany — ²Inst. for Theor. Physics, Vienna University of Technology, Wiedner Hauptstr. 8-10, A-1040 Vienna, Austria — ³Inst. for Particle and Nuclear Physics, Wigner Research Center for Physics, Hungarian Academy of Sciences, H-1525 Budapest, Hungary — ⁴Frankfurt Institute for Advanced Studies, Ruth-Moufang-Str. 1 D-60438 Frankfurt am Main, Germany

We present an effective model for low-energy hadron phenomenology, called extended linear sigma model (eLSM), which is based on chiral symmetry and dilatation invariance. The d.o.f. in the mesonic sector are the (pseudo)scalar and (axial-)vector quark-antiquark fields, as well as the scalar and the pseudoscalar glueballs. A good description of the existing PDG data on masses and decay widths is achieved and predictions for future experiments are shown. In the baryonic sector the nucleon doublet (the nucleon and its chiral partner) are introduced through the mirror assignment: in this way a contribution to the nucleon mass, which does not originate from the chiral condensate, is possible and turns out to be sizable. Decays and scattering processes involving nucleons are presented. In the end, an outlook for future studies in both the mesonic and baryonic sectors is discussed.

HK 44.2 Di 17:15 HSZ-403

Phenomenology of the Scalar-Isoscalar Resonances $f_0(1370)$, $f_0(1500)$ and $f_0(1710)$ — ●STANISLAUS JANOWSKI¹, DENIS PARGANLIJA², FRANCESCO GIACOSA¹, and DIRK H. RISCHKE^{1,3} — ¹Institut für Theoretische Physik, Goethe-Universität Frankfurt, Max-von-Laue-Straße 1, D-60438 Frankfurt — ²Institute for Theoretical Physics, Vienna University of Technology, Wiedner Hauptstr. 8-10, A-1040 Vienna, Austria — ³Frankfurt Institute for Advanced Studies (FIAS), Ruth-Moufang-Straße 1, D-60438 Frankfurt

In the framework of the $U(3)_R \times U(3)_L$ chirally symmetric extended Linear Sigma Model (eLSM) with three flavors we investigate the phenomenology of the three scalar-isoscalar resonances $f_0(1370)$, $f_0(1500)$, and $f_0(1710)$. The degrees of freedom of the eLSM are (pseudo)scalars and axial(vectors) as well as a scalar glueball. In order to understand which of the scalar-isoscalar states is predominantly a nonstrange, $\bar{n}n = (\bar{u}u + \bar{d}d)/\sqrt{2}$, and a strange, $\bar{s}s$, quark-antiquark state as well as predominantly a scalar glueball state we study their mixing behavior. This is the continuation of the work arXiv:1103.3238 and aims towards a full determination of the structure of the scalar-isoscalar mesons above 1 GeV.

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

HK 44.3 Di 17:30 HSZ-403

A $U(4)_r \times U(4)_l$ linear sigma model with (axial-)vector mesons — ●WALAA ESHRAIM¹, 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 a linear sigma model with $U(4)_r \times U(4)_l$ global chiral symmetry, which in addition to scalar and pseudoscalar mesons also includes vector and axial-vector mesons. Apart from three new parameters pertaining to the charm degree of freedom, the parameters of the model are fixed from the $N_f = 3$ flavor sector. Our results for the charmed meson masses and weak decay constants are in surprisingly good agreement with experimental data, with the marked exception of the scalar degrees of freedom, providing an indication that these states may not adhere to the standard quark-antiquark picture of a meson. Supported by DAAD and HGS-HIRE.

HK 44.4 Di 17:45 HSZ-403

The $K\Sigma$ production in pion- and photo-induced reactions up to 2.0 GeV — ●XU CAO, VITALY SHKLYAR, and HORST LENSKE — Institut für Theoretische Physik, Universität Gießen

A coupled-channel model based on effective Lagrangians is applied to the combined analysis of the $(\pi, \gamma)N \rightarrow K\Sigma$ reactions up to the center of mass energy 2 GeV. The couplings constants and resonance parameters of the $K\Sigma$ state are extracted in the calculation. The main resonance contributions to the process come from the $S_{11}(1650)$, $D_{13}(1520)$, $D_{15}(1675)$, $P_{13}(1900)$, $P_{31}(1750)$, $D_{33}(1700)$ and $D_{35}(1930)$ states. The coherent sum of resonances and background contributions is essential to describe the recent photoproduction data obtained by the CLAS, CBELSA, LEPS, and GRAAL groups.

HK 44.5 Di 18:00 HSZ-403

Hadron form factors and large-Nc phenomenology — ●PERE MASJUAN — Institut für Kernphysik, Johannes Gutenberg Universität Mainz

We suggest using the half-width rule to make an estimate of the $1/N_c$ errors in hadronic models containing resonances. We show simple consequences of these ideas for the analysis of meson Regge trajectories and for the pion, nucleon and generalized hadronic form factors.

HK 44.6 Di 18:15 HSZ-403

Photon-fusion reactions from the chiral Lagrangian with dynamical light vector mesons — ●IGOR DANILKIN¹, MATTHIAS LUTZ¹, STEFAN LEUPOLD², and CARLA TERSCHLÜSEN² — ¹GSI, Planckstraße 1, 64291 Darmstadt, Germany — ²Uppsala Universitet, Box 516, 75120 Uppsala, Sweden

We study the reactions $\gamma\gamma \rightarrow \pi^0\pi^0, \pi^+\pi^-, K^0\bar{K}^0, K^+K^-, \eta\eta$ and $\pi^0\eta$ based on a chiral Lagrangian with dynamical light vector mesons as formulated within the hadrogenesis conjecture. At present our chiral Lagrangian contains 5 unknown parameters that are relevant for the photon fusion reactions. They parameterize the strength of interaction terms involving two vector meson fields. These parameters are fitted to photon fusion data $\gamma\gamma \rightarrow \pi^0\pi^0, \pi^+\pi^-, \pi^0\eta$ and to the decay $\eta \rightarrow \pi^0\gamma\gamma$. In order to derive gauge invariant reaction amplitudes in the resonance region constraints from micro-causality and exact coupled-channel unitarity are used. Our results are in good agreement with the existing experimental data from threshold up to about 0.9 GeV for the two-pion final states. The a_0 meson in the $\pi^0\eta$ channel is dynamically generated and an accurate reproduction of the $\gamma\gamma \rightarrow \pi^0\eta$ data is achieved up to 1.2 GeV. Based on our parameter sets we predict the $\gamma\gamma \rightarrow K^0\bar{K}^0, K^+K^-, \eta\eta$ cross sections [1].

[1] I. V. Danilkin, M. F. M. Lutz, S. Leupold and C. Terschlusen, arXiv:1211.1503 [hep-ph].

HK 44.7 Di 18:30 HSZ-403

Sum rules for light-by-light scattering — ●VLADYSLAV PAUK^{1,2}, VLADIMIR PASKALUTSA¹, and MARC VANDERHAEGHEN¹ — ¹Johannes Gutenberg University, Mainz — ²National Taras Shevchenko University of Kyiv

Title: Light-by-light scattering sum rules and meson transition form factors

In the seminar a set of exact sum rules for the light-by-light fusion process will be discussed. These sum rules involve energy weighted integrals of light-by-light fusion cross sections, which can be measured at e^+e^- colliders and allow one to constrain the energy behavior of these response functions. The implication of the sum rules within a perturbative quantum field theory framework will be shown. Specifically, electrodynamics of spin-0, spin-1/2, and spin-1 fields will be considered at tree level and beyond. The sum rules will then be applied to the production of mesons by a virtual photon and a real photon. It will be demonstrated that these sum rules imply non-trivial new relations between the two-photon decay widths of mesons and the gamma* gamma transition form factors for (pseudo-) scalar, axial-vector and tensor mesons. The phenomenological implications of these results for mesons both in the light quark sector and in the charm quark sector will be discussed. The seminar will also give an outlook on the application of these new results to constrain the hadronic uncertainties due to the light-by-light contribution to the muon's anomalous magnetic moment.

HK 44.8 Di 18:45 HSZ-403

Updated determinations of the pion-nucleon sigma term and the strangeness content of the nucleon with covariant baryon

chiral perturbation theory — •JOSE MANUEL ALARCON¹, JORGE MARTIN CAMALICH², and JOSE ANTONIO OLLER³ — ¹Institut für Kernphysik, Johannes Gutenberg Universität, Mainz D-55099, Germany — ²Department of Physics and Astronomy, University of Sussex, BN1 9QH, Brighton, UK — ³Departamento de Física. Universidad de Murcia. E-30071, Murcia, Spain

In this talk I want to present the community our recent determinations

of $\sigma_{\pi N}$ and σ_s employing covariant baryon chiral perturbation theory and updated experimental information. We show how these determinations overcome the difficulties that the old values of $\sigma_{\pi N} = 45$ MeV and $y \approx 0.23$ have when trying to explain the modern experiments regarding the nuclear structure and LQCD determinations. From our results, a new scenario emerges where $\sigma_{\pi N}$ and σ_s are in good agreement with updated phenomenology and recent LQCD calculations.