HK 39: Hadron Structure and Spectroscopy VII

Zeit: Mittwoch 16:30–18:30 Raum: S1/01 A5

Gruppenbericht HK 39.1 Mi 16:30 S1/01 A5

Chiral extrapolation of D meson masses — •Xiao-Yu Guo and Matthias F. M. Lutz — GSI Helmholtzzentrum fuer Schwerionenforschung GmbH, Darmstadt, Germany

We consider the quark-mass dependence of open-charm meson masses. The chiral Lagrangian formulated with the ground-state mesons with $J^P = 0^-$ and $J^P = 1^-$ quantum numbers is applied at the one loop level. The implications of the heavy-quark spin symmetry are worked out. We scrutinize the results from various QCD lattice simulations for the masses of the charmed meson ground-states. Finite volume effects are considered systematically.

HK 39.2 Mi 17:00 S1/01 A5

The Low-Energy Constants of the extended Linear Sigma Model — •Florian Divotgey, Francesco Giacosa, Peter Kovacs, and Dirk H. Rischke — Institut für Theoretische Physik, Goethe-Universität Frankfurt am Main

The low-energy dynamics of Quantum Chromodynamics (QCD) is fully determined by the interactions of the (pseudo-) Nambu-Goldstone bosons of spontaneous chiral symmetry breaking, i.e., for two quark flavors, the pions. Pion dynamics is described by the low-energy effective theory of QCD, chiral perturbation theory (ChPT), which is based on the nonlinear realization of chiral symmetry [1]. An alternative description is provided by the Linear Sigma Model, where chiral symmetry is linearly realized. An extended version of this model, the so-called extended Linear Sigma Model (eLSM) was recently developed [2,3] which incorporates all $J^P = 0^{\pm}, 1^{\pm}$ $\bar{q}q$ mesons up to 2 GeV in mass. A fit of the coupling constants of this model to experimentally measured masses and decay widths has a surprisingly good quality [3]. In this talk, it is demonstrated that the low-energy limit of the eLSM, obtained by integrating out all fields which are heavier than the pions, assumes the same form as ChPT. Moreover, the low-energy constants (LECs) of the eLSM agree with those of ChPT.

[1] J. Gasser and H. Leutwyler, Annals Phys. **158**, 142 (1984).
[2] D. Parganlija, F. Giacosa and D. H. Rischke, Phys. Rev. D **82**, 054024 (2010).
[3] D. Parganlija, P. Kovacs, G. Wolf, F. Giacosa and D. H. Rischke, Phys. Rev. D **87**, no. 1, 014011 (2013).

HK 39.3 Mi 17:15 S1/01 A5

Tetraquarks in a Dyson-Schwinger Approach — •Paul Christian Wallbott, Gernot Eichmann, Christian S. Fischer, and Walter Heupel — Justus Liebig university, Giessen, Germany

We present numerical solutions of the four-quark Bethe-Salpeter equation for ground-state scalar tetraquarks with $J^{PC} = 0^{++}$. In a recent work [1] it was shown, that the four-body equation dynamically generates pseudoscalar-meson poles in the Bethe-Salpeter amplitude. The resulting tetraquarks are genuine four-quark states, dominated by pseudoscalar meson-meson correlations. These lead to an isoscalar tetraquark mass $M_\sigma \sim 350$ MeV which is comparable to that of the $\sigma/f_0(500)$. Based on these findings we present a second solution of the equation, with the pseudoscalar meson poles explicitly built in the Bethe-Salpeter amplitude.

[1] G. Eichmann, C. S. Fischer and W. Heupel, accepted by PLB, arXiv:1508.07178 [hep-ph]

HK 39.4 Mi 17:30 S1/01 A5

The $X(3872)$ as a $D^0\bar{D}^0\pi^0$ bound state — •Marcel Schmidt, Maximilian Jansen, and Hans-Werner Hammer — Institut für Kernphysik, TU Darmstadt, 64289 Darmstadt, Germany

Three-body physics may play a crucial role for the exotic charmonium state $X(3872)$ which can be interpreted as a hadronic molecule. We propose a new effective field theory with D^0, $\bar{D}^0$ and π^0 fields, considering Galilean invariance to be an exact symmetry of the problem. Moreover, heavy D^{0*} ($\bar{D}^{0*}$) mesons implicitly enter as p-wave resonances in the $D^0\pi^0$ ($\bar{D}^0\pi^0$) system. They are treated using dimeson auxiliary fields in the respective channels. In this talk, we first discuss the underlying Lagrangian. Afterwards, we construct the nonperturbative three-body amplitude for the $X(3872)$ and elucidate its relation to the $D^0\bar{D}^{0*}$ scattering length.

HK 39.5 Mi 17:45 S1/01 A5

Investigation of neutral pion decays using the nonperturbative Dyson-Schwinger formalism — •Esther Weil, Gernot Eichmann, Christian Fischer, and Richard Williams — Justus-Liebig Universität Giessen, Deutschland

In this talk we present an investigation of neutral pion decays within this framework of Dyson-Schiwnger and Bethe-Salpeter equations. Our main objective is to determine the off-shell pion form factor ($\pi^0 \to \gamma\gamma$), which serves as an important ingredient for calculations of other π^0 decays. Examples include the three-body decay ($\pi^0 \to \gamma e^+e^-$) or the rare decay ($\pi^0 \to e^+e^-$). The pion form factor is also an important part in the hadronic light-by-light contribution to g-2. By systematically comparing with other approaches, we aim to improve the precision of the theory prediction within the Standard Model. This, together with improved experimental results, will lead to stronger constraints on various beyond-the-Standard-Model theories.

HK 39.6 Mi 18:00 S1/01 A5

$K_0^*(800)$ (or κ) as a companion pole of $K_0^*(1430)$ — •Thomas Wolkanowski[1], Milena Sołtysiak[2], Francesco Giacosa[1,2], and Dirk H. Rischke[1] — [1]Institut für Theoretische Physik, Goethe-Universität Frankfurt am Main, Deutschland — [2]Institute of Physics, Jan Kochanowski University Kielce, Poland

We study the light scalar meson sector up to 1.8 GeV in mass using a model Lagrangian which features a single kaonic state (the resonance $K_0^*(1430)$) coupled to kaons and pions. By performing a fit of the parameters of the Lagrangian to πK phase shift data in the $I = 1/2$, $J = 0$ channel, we show that $K_0^*(800)$ (or κ) emerges as a dynamically generated companion pole of $K_0^*(1430)$. This is a result of resumming quantum fluctuations to one-loop order (with one kaon and one pion running in the loop) in the self-energy of $K_0^*(1430)$. We determine the position of the poles in the complex plane. A large-N_c study confirms that $K_0^*(1430)$ is predominantly a quarkonium and that $K_0^*(800)$ is a molecular-like dynamically generated state.

HK 39.7 Mi 18:15 S1/01 A5

Coupled-channel analysis of the omega-meson photoproduction in the resonance energy region — •Vitaly Shklyar, Horst Lenske, and Ulrich Mosel — Institut für Theoretische Physik I, Giessen Universität

Omega-meson photoproduction is studied to explore the nucleon resonance couplings to the final omega-nucleon system. The production amplitude is obtained within a coupled-channel unitary Lagrangian model which allows for the simultaneous analysis of pion- and photon-induced reactions. The resonance parameters are constrained by direct comparison with the available experimental data. The present study extends our previous results by including all available experimental data on the omega photoproduction off the proton and neutron.