HK 40: Hadron Structure and Spectroscopy VI

Zeit: Mittwoch 16:30–18:30 Raum: HS 13

Gruppenbericht HK 40.1 Mi 16:30 HS 13

The quark-mass dependence of light meson masses and decay constants — •Xiao-Yu Guo[1] and Matthias F.M. Lutz[1,2] — [1]GSI Helmholtzzentrum, Planckstr. 1, 64291 Darmstadt, Germany — [2]Technische Universität Darmstadt, D-64289 Darmstadt, Germany

We study the dependence of light meson masses and decay constants on the up, down and strange quark masses. The role of dynamical vector meson degrees of freedom is scrutinized in terms of an effective chiral Lagrangian based on the hadrogenesis conjecture. It is illustrated that an order-by-order renormalizable effective field theory arises once specific conditions on the low-energy constants are imposed. At the one-loop level, we derive the chiral corrections to the self-energies of the Goldstone bosons and vector mesons as well as the decay constants of the Goldstone bosons. According to the chiral formula, we scrutinize QCD lattice data on the masses of the light vector mesons from PACS-CS, QCDSF-UK and HSC. Particular attention is paid to the $\omega - \phi$ mixing phenomenon, which is demonstrated to show a strong mass dependence. Applying the low-energy constants determined accordingly, further implications are computed on the pion and kaon decay constants for QCD lattice ensembles of HPQCD, CLS and ETMC. The dynamical vector mesons lead to significant impact on the evaluation of Gasser and Leutwyler's LECs.

HK 40.2 Mi 17:00 HS 13

Toplogical effect for three-particle problems in a box — •Martin Ebert[1] and Hans-Werner Hammer[1,2] — [1]IKP, TU Darmstadt — [2]EMMI, GSI Darmstadt

The binding energy of bosonic three-particle systems in a box is investigated with an effective field theory. The finite volume corrections to the binding energy are calculated perturbatively in inverse powers of box size L. Besides the effect described by Lüscher [1], special interest is given to the influence of the topological effect [2]. It describes the possibility of a composite particle leaving the finite volume through periodic boundaries. We show that this effect can be neglected at LO and becomes important at NLO. The analytic results are compared to numerical calculations analogous to [3].

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[1] M. Lüscher, Nucl. Phys. B 354, 531 (1991)
[2] S. Bour *et al.*, Phys. Rev. D 84, 091503 (2011)
[3] M. Döring *et al.*, Phys. Rev. D 97, 114508 (2018)

HK 40.3 Mi 17:15 HS 13

Monte Carlo acceptance studies of the diffractive production of the $\eta^{(\prime)}\pi^-$ system at COMPASS — •Henri Pekeler, Mikhail Mikhasenko, Waldemar Renz, Mathias Wagner, and Bernhard Ketzer for the COMPASS-Collaboration — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

The diffractive production of the $\eta^{(\prime)}\pi^-$ system in the $p\pi^- \to \eta^{(\prime)}\pi^- p'$ channel is very exciting because the partial wave with orbital angular momentum $L = 1$ between the two pseudoscalars carries spin-exotic quantum numbers $J^{PC} = 1^{-+}$. The observation of a resonance in this wave is considered a smoking gun for a hybrid meson with gluonic degrees of freedom.

For the partial-wave analysis, a precise knowledge of the acceptance of the apparatus is essential. At COMPASS, there exists a new GEANT4-based simulation framework, which needs to be validated for the given processes. In addition to the correct geometric description of the COMPASS experiment, the responses of the recoil proton detector, the tracking system and the electromagnetic calorimeters have been investigated. For the production of the large Monte Carlo data sample, BlueWaters, one of the most powerful supercomputers in the world, located at the University of Illinois campus in Champaign, is used. In the talk, I will present the validation of the Monte Carlo chain and discuss the multi-dimensional acceptance deduced therewith.

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HK 40.4 Mi 17:30 HS 13

Hadronic decays of the excited pseudoscalar glueball, hybrid mesons and charmonium states — •Walaa Eshraim[1], Stefan Schramm[2], Christian Fischer[3], and Francesco Giacosa[4] — [1]Institute for Theoretical Physics, Goethe University, Max-von-Laue-Str. 1, D 60438 Frankfurt am Main, Germany — [2]Frankfurt Institute for Advanced Studies, Goethe University, Ruth-Moufang-Str. 1, D 60438 Frankfurt am Main, Germany — [3]Institut für Theoretische Physik, Justus-Liebig-Universität Giessen, 35392 Giessen, Germany — [4]Institute of Physics, Jan Kochanowski University, ul. Swietokrzyska 15, 25-406 Kielce, Poland.

We study three different chiral Lagrangians that describe the two- and three-body decays of an excited pseudoscalar glueball, $J^{PC} = 0^{*-+}$, into light mesons and charmonium states as well as into a scalar and pseudoscalar glueball. We compute the decay channels for an excited pseudoscalar glueball with a mass of 3.7 GeV and consider a ground state pseudoscalar glueball of mass 2.6 GeV, following predictions from lattice QCD simulations. Furthermore, we enlarge the extended Linear Sigma Model (eLSM) by including nonets of low-lying hybrids in a chiral invariant frameowrk. Then, we predict the masses and decay modes of the (lightest) hybrid states in the framework (eLSM). Moreover, we calculate the two- and three-body decays of the ground-state (pseudo-)scalar charmonia η_c and χ_{c0} in the framework of a $U(4)_r \times U(4)_l$ symmetric linear sigma model with (pseudo-)scalar and (axial-) vector mesons.

HK 40.5 Mi 17:45 HS 13

Coupled partial wave analysis of two-photon reactions at BESIII — •Meike Küssner — Institut für Experimentalphysik I, Ruhr-Universität Bochum

The BESIII experiment at the BEPCII electron-positron collider in Beijing offers excellent opportunities to study two-photon reactions, due to the numerous high statistics data samples which were recorded at center of mass energies between $\sqrt{s} = 2 - 4.6$ GeV.
Decades ago, particles that consist solely of gluons, so-called glueballs, have been predicted from theory. According to present knowledge, lattice-QCD predicts several glueball candidates in the mass range of light mesons between 1.5 and 4 GeV/c^2. Studying the nature of light mesons in two-photon decays, offers indirect information of their gluonic content and acts as a glueball filter. However, it turns out that experimental identification of glueballs is often ambiguous due to the mixing of glueballs with ordinary mesons and interference.
In this analysis a coupled partial wave analysis will be used to disentangle these ambiguities. Besides a discussion of the performed data selection, preliminary results of the performed partial wave analysis will be presented as well as future perspectives.

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HK 40.6 Mi 18:00 HS 13

Study of Light Mesons in Two-Photon Interactions at BESIII — •Jiaqi Li — Ruhr-Universität Bochum, Germany

The BESIII experiment at the symmetric electron-positron collider BEPCII in Beijing has recorded large data samples at center of mass energies between 2 and 4.6 GeV. The experiment is well suited to study the production of light mesons in two-photon interactions.

Two-photon physics provides an excellent opportunity to study light mesons with quantum numbers such as $0^{\pm+}$ and $2^{\pm+}$. The $\gamma\gamma$ width of resonances can be determined from two-photon processes, which is an important measurement to understand the nature of some resonances like $a_2(1320)$ and $\eta(1405)$, which are discussed to be exotic particles.

Recent results and future prospects will be presented in this contribution.

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HK 40.7 Mi 18:15 HS 13

Insights into the spin-exotic $\pi_1(1600)$ meson — •Fabian Krinner for the COMPASS-Collaboration — Technische Universität München - Physik Department - E18

The COMPASS experiment is a two-stage multi-purpose spectrometer. One of its main goals is the study of the light-meson spectrum. The flagship channel is the diffractive process $\pi^- p \to \pi^-\pi^+\pi^- p$, for which COMPASS has collected a large data sample of 46×10^6 events.

One focus of our analysis lies on mesons that have spin-exotic quantum numbers forbidden for $q\bar{q}$ states. The controversial $\pi_1(1600)$ with $J^{PC} = 1^{-+}$ quantum numbers is a prominent example. To search for this state, a detailed partial-wave analysis (PWA) was performed on

the collected data employing a novel method, called freed-isobar PWA. This method not only reduces potential model bias of the PWA and but also allows us to study the dynamic amplitudes of the 2π subsystems with well-defined J^{PC} quantum numbers in the 3π final state. Using the freed-isobar PWA, we have studied the $J^{PC} = 1^{-+}$ wave with unprecedented level of detail and dimensionality.

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