# HK 29: Hadron Structure and Spectroscopy III

Time: Wednesday 15:45–17:15 Location: HS 3 Physik

**Group Report** HK 29.1 Wed 15:45 HS 3 Physik

**Light-Meson Spectroscopy at COMPASS** — •Julien Beckers for the COMPASS-Collaboration — Technische Universität München

COMPASS is a multi-purpose fixed-target experiment at the CERN SPS. One of its main goals is to probe the strong interaction at low energies by studying the excitation spectrum of light mesons in diffractive scattering reactions of a 190 GeV/$c$ hadron beam. This is done by decomposing the data into partial-wave amplitudes with well-defined quantum numbers and searching for resonances in these amplitudes.

We have collected the world's largest datasets of various final states. First and foremost, COMPASS' flagship $\pi^-\pi^-\pi^+$ channel has allowed high-precision measurements of many light mesons. Its strange equivalent, $K^-\pi^-\pi^+$, has given insight into the lesser known strange-meson spectrum. New analyses of final states with kaons complement their findings. After briefly presenting the analysis method, we will discuss measurements in the $K^0_S K^-$ final state, which gives access exclusively to $a_J$ mesons at higher invariant masses.

COMPASS has also contributed significantly in the search for exotic (non-$q\bar{q}$) mesons. We will present novel analyses of the $\omega\pi^-\pi^0$ and $\pi^-\pi^-\pi^+\eta$ final states, which are especially interesting as the lightest hybrid meson is theorized to decay into both of these final states.

The COMPASS data also allows for measurements beyond typical spectroscopy. We will discuss one such analysis of the nonresonant double-Regge exchange process, done in collaboration with JPAC.

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HK 29.2 Wed 16:15 HS 3 Physik

**Partial-wave decomposition of the diffractively produced $\pi^-\pi^+\pi^-\eta$ final state at COMPASS** — •David Spülbeck[1], Henri Pekeler[1], Philipp Haas[2], Mikhail Mikhasenko[3], and Bernhard Ketzer[1] for the COMPASS-Collaboration — [1]Universität Bonn — [2]Technische Universität München — [3]Universität Bochum

The COMPASS experiment at the CERN SPS was a versatile fixed-target experiment that collected data between 2002 and 2022. The data support a rich physics program from hadron structure to spectroscopy. The latter includes the study of light isovector mesons with total spin $J$, i.e., $a_J$ and $\pi_J$, produced through diffractive scattering of a 190 GeV/$c$ $\pi^-$ beam off a liquid-hydrogen target. Large data sets of multiparticle exclusive final states containing charged and neutral particles were recorded, providing also unique opportunities to study the spin-exotic meson $\pi_1(1600)$.

We present the first partial-wave decomposition of the $\pi^-\pi^+\pi^-\eta$ final state, which spans a wide range of decay channels, such as $f_1(1285)\pi^-$, $a_2^-(1320)\eta$, and $\rho(770)a_0^-(980)$. Most of these channels are studied for the first time with COMPASS data. This analysis also includes decay channels predicted by theoretical models for the lightest hybrid meson, providing the opportunity to verify the hybrid meson hypothesis of the $\pi_1(1600)$.

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HK 29.3 Wed 16:30 HS 3 Physik

**Light and strange meson spectrum from functional methods beyond Rainbow-Ladder** — •Stephan Hagel and Christian Fischer — Institut für Theoretische Physik, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany

The study of meson spectra has long been a central topic in theoretical hadron physics, with a variety of approaches and frameworks employed to tackle the problem. One such framework involves the Dyson-Schwinger and Bethe-Salpeter equations, which have been extensively studied within the Rainbow-Ladder truncation. While there has been some progress in going beyond this truncation, it remains a difficult challenge.

In this talk, we present a method for constructing a quark self-energy that satisfies the axialvector Ward-Takahashi identity, starting from any quark-antiquark scattering kernel. By applying this approach to a scattering kernel derived from a 3PI effective action, we compute the spectrum of light and strange mesons with various quantum numbers. In particular, we discuss the kaon spectrum for J=0...5, relevant for the AMBER experiment.

HK 29.4 Wed 16:45 HS 3 Physik

**Search for conventional charmonia and light exotic candidates in the decay $\psi(2S) \to \gamma\eta'\pi^+\pi^-$ at BESIII** — •Frederik Weidner, Tessa Bertelsmeier, Jans Böing, Anja Brüggemann, Lotta Frese, Nikolai in der Wiesche, Lois Kröger, Hannah Neuwirth, and Alfons Khoukaz for the BESIII Germany-Collaboration — Universität Münster, Münster, Germany

In recent years, the search for exotic hadrons has uncovered an increasing number of states that seem to be incompatible with the conventional classification as two or three quark states. Examples for these are the $\pi_1(1600)$ or the $X(1835)$.

One way to study these states is the analysis of the $\psi(2S)$ data sample of the BESIII experiment, which also allows the precise determination of the branching ratios of lower lying charmonium states such as $\eta_c$ and $\chi_{cJ}$. Considering the decay of the $\chi_{c1,2}$ charmonia into three pseudoscalar mesons, the spin-exotic quantum numbers $J^{PC} = 1^{-+}$ can be accessed. In addition, precision measurements of the branching ratios of the $\chi_{cJ}$ states can help to solidify our understanding of charmonia and can be used as input to models such as NRQCD.

In this talk, the search for the $\pi_1(1600)$ in the decay $\chi_{c2} \to \eta'\pi^+\pi^-$ using a partial wave analysis, the determination of branching ratios of $\chi_{cJ}, \eta_c \to \eta'\pi^+\pi^-$ and the search for additional states in the $\eta'\pi^+\pi^-$ system, are presented. This work is supported by the German Research Foundation under project number 443159800 and GRK 2149/2 and by the Ministry for Culture and Science of the State North Rhine-Westphalia under funding code NW21-024-E.

HK 29.5 Wed 17:00 HS 3 Physik

**Search for exotic states in $\eta_c$ decays at BESIII** — Tessa Bertelsmeier[1], Jans Böing[1], •Anja Brüggemann[1], Lotta Frese[1], Nils Hüsken[2], Nikolai in der Wiesche[1], Lois Kröger[1], Hannah Neuwirth[1], Frederik Weidner[1], and Alfons Khoukaz[1] for the BESIII Germany-Collaboration — [1]Universität Münster, Germany — [2]Johannes Gutenberg-Universität Mainz, Germany

The BESIII detector at the $e^+e^-$ collider BEPCII in Beijing, China, provides the world's largest data sample of the charmonium $J/\psi$ with more than 10 billion events collected from 2009 to 2019.

Starting from the radiative $J/\psi$ decay into $\gamma\eta_c$, we analyse the reactions $\eta_c \to \eta' h\bar{h}$ (with $h\bar{h} = \pi^0\pi^0$, $\pi^+\pi^-$, $2(\pi^+\pi^-)$, $K^+K^-$, $K_SK_S$, $\eta\eta$) to determine the corresponding branching ratios as well as the mass and width of the ground-state charmonium $\eta_c$ based on signal yields much higher than achieved in former analyses. Moreover, these mesonic $\eta_c$ decays provide the opportunity to investigate possible exotic content in $h\bar{h}$ intermediate states, that lie in the mass region below 2 GeV/$c^2$, where the lightest glueball is predicted.

Our studies are based on a partial wave analysis approach that gives access to the properties of the $\eta_c$ charmonium and to the partial decay widths of contributing resonances decaying into the $h\bar{h}$ subsystems. These widths are directly comparable to theoretical predictions, which assume glueball admixtures carried by certain considered resonances.

The current status of the analysis is presented.

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