HK 41: Hadron Structure and Spectroscopy V

Time: Thursday 14:00–15:30 Location: HS 3 Physik

HK 41.1 Thu 14:00 HS 3 Physik

Tetraquark Spectroscopy in Semileptonic B Decays at LHCb — •Piet Nogga — Helmholtz-Institut für Strahlen- und Kernphysik Nussallee 14-16 D-53115 Bonn

The last decade has seen a wealth of discoveries of new hadronic states with heavy quarks, many of which are outside of the scope of the naive quark model of conventional mesons and baryons. The LHCb experiment, designed to research heavy flavor hadrons in pp collisions, is especially well suited to investigate the nature of these states. An under-exploited source of hadronic resonances are semileptonic B decays. There are no published LHCb papers searching for exotic states in semileptonic decays but we expect significant exotic contributions since semileptonic decays comprise 10% of all B decays. Furthermore, the final state in semileptonic decays is relatively clean, since the hadronic system is produced in isolation, avoiding complicated final state interactions from crossed channels. On the other hand, the background contribution is large due to the missing energy in the system. This presentation will discuss tetraquark spectroscopy in $B^{0[-]}_{(s)} \to D^{0[+]}\pi^{+[-]}(K^+)\mu^-\bar{\nu}_\mu$ decays with an emphasis on their possible molecular nature.

HK 41.2 Thu 14:15 HS 3 Physik

A Study of DD^*K System — •Anuvind Asokan[1], Feng-Kun Guo[2,3,4], Christoph Hanhart[1], and Xu Zhang[2] — [1]Institute for Advanced Simulation 4, Forschungszentrum Jülich, D-52425 Jülich, Germany — [2]CAS Key Laboratory of Theoretical Physics, Institute of Theoretical Physics, Chinese Academy of Sciences, Beijing 100190, China — [3]School of Physical Sciences, University of Chinese Academy of Sciences, Beijing 100049, China — [4]Peng Huanwu Collaborative Center for Research and Education, Beihang University, Beijing 100191, China

We present our investigation of the DD^*K system. This three-body system is of particular interest due to the presence of a bound state in each of the two-body subsystems — $D^*_{s0}(2317)$ in DK, $D_{s1}(2460)$ in D^*K and $T_{cc}(3875)$ in DD^*, respectively. We employ a relativistic formalism using time ordered perturbation theory. We report the status of our calculations with special emphasis on poles location and width of the emerging three-body state.

HK 41.3 Thu 14:30 HS 3 Physik

Search for $\Lambda_b^0/\Xi_b^0 \to \Lambda\Lambda\bar{p}D_s^+$ with the LHCb experiment — •Ellinor Eckstein — Helmholtz-Institut für Strahlen- und Kernphysik (HISKP) Bonn

One of the most prominent questions in particle physics over the past decades is the nature of dark matter (DM). The sexaquark (S), a tightly bound state of $uuddss$ valence quark content, is a candidate for hadronic DM, proposed first by Glennys R. Farrar. The existence of such a state would furthermore have implications for the field of re- search regarding the substructure of exotic hadrons. At the LHCb experiment, the S, if it exists, is expected to occur in hadronic final states of b -baryon decays such as $\Lambda_b^0/\Xi_b^0 \to S\bar{p}D_s^+$. The decay $\Lambda_b^0/\Xi_b^0 \to \Lambda\Lambda\bar{p}D_s^+$, with the Λs escaping the detector, is one of the main backgrounds for S searches. At the same time, if the Λs can be reconstructed, it serves as a sensitivity check. With two long lived neutral particles in the final state and CKM suppression the first observation of this decay is a challenging task.

This talk will present the current status of the search for $\Lambda_b^0/\Xi_b^0 \to \Lambda\Lambda\bar{p}D_s^+$ in Run2 data of the LHCb experiment. Moreover, the potential of Run3 data, offering not only an increase in statistics, but a purely software based trigger with full track reconstruction in real time, resulting in an increase in trigger efficiency for hadronic decays, will be discussed.

HK 41.4 Thu 14:45 HS 3 Physik

Comparison of Sideband-Subtraction Methods for the Background Subtraction in η_c Decays — Tessa Bertelsmeier, Jans Böing, Anja Brüggemann, Lotta Frese, Nikolai in der Wiesche, Lois Kröger, •Hannah Neuwirth, Frederik Weidner, and Alfons Khoukaz for the BESIII Germany-Collaboration — Universität Münster, Germany

In particle physics, an accurate separation of signal and background events is essential to obtain reliable results. In particular, irreducible background contributions make it difficult to determine whether an event contributes to signal or background.

This study compares the strengths and limitations of two background subtraction methods: the single weight sideband subtraction and the Q-value method. The first method statistically removes background contributions from defined sideband regions, assuming similar properties of the background in sideband and signal regions. The second method calculates event-by-event probability-based weights by analysing local phase space neighbourhoods in a certain reference coordinate, allowing the separation of signal and background.

Using the world's largest J/ψ data set from the BESIII experiment, the methods are applied to Monte Carlo simulations and experimental data of the $J/\psi \to \gamma(\eta_c \to \eta' K^+K^-)$ decay to remove non-η' background, which is crucial for further analysis.

The current status of the analysis will be presented.

This work is supported by the German Research Foundation (DFG) under the project number 547123630 and the DFG GRK 2149/2.

HK 41.5 Thu 15:00 HS 3 Physik

Performance test of the KF Particle package for heavy-flavor hadron lifetime measurements with the ALICE detector — •Oleksii Lubynets for the ALICE Germany-Collaboration — Physikalisches Institut Universität Heidelberg

The lifetimes of heavy-flavor (HF) hadrons can be described using the heavy-quark expansion (HQE) method, which expresses the decay width as a series of $(1/m_Q)^n$, where m_Q is the mass of the HF quark. The predicted lifetimes can vary significantly depending on how higher-order terms in the expansion are handled. This makes lifetime measurements a valuable tool for refining and validating the most accurate approaches within the HQE framework. Recent measurements of the Ω_c^0 baryon lifetime by the LHCb and Belle II show significant deviations from previous results obtained at CERN and Fermilab. These discrepancies highlight the need for new precise measurements.
The HF hadrons decay within the ALICE detector volume and are reconstructed through their decay topology using methods of the Kalman Filter algorithm. To improve the resolution of decay parameters and increase the statistical significance of the measurements, a set of constraints is applied. These constraints take into account the production vertex of the HF hadron (topological constraint) and the expected mass of the decaying particles (mass constraint).
In this work, the KF Particle package was employed to reconstruct the $\Lambda_c \to pK\pi$ decay in pp collisions at $\sqrt{s} = 13.6\,\text{TeV}$. The performance of the KF Particle package in measuring the Λ_c lifetime and the effect of the applied constraints are discussed.

HK 41.6 Thu 15:15 HS 3 Physik

Search for $\chi_{c1}(3872) \to p\bar{p}$ in $B^+ \to p\bar{p}K^+$ — •Kai Habermann, Sebastian Neubert, and Jascha Grabowski — HISKP, University of Bonn, Germany

We present and analysis, that aims to measure the branching ratio of the $\chi_{c1}(3871)$ decaying into the $(p\bar{p})$ final state using data collected by the LHCb experiment. The ultimate goal is to enable the observation and study of the $\chi_{c1}(3871)$ formed in $p\bar{p}$ collisions, paving the way for future experiments. The $\chi_{c1}(3871)$, commonly known as $X(3872)$, is an enigmatic state in the charmonium spectrum, widely studied due to its unconventional properties, including its proximity to the $D^0\bar{D}^{*0}$ threshold and its debated nature as a likely exotic state such as a tetraquark or hadronic molecule. This study utilizes the $B \to p\bar{p}K$ decay channel to extract the charmonium spectrum in the $p\bar{p}$ subsytem. In addition to the $\chi_{c1}(3871)$, this allows for precise measurements of the mass and width of the $\eta_c(1S)$ and $\eta_c(2S)$ states. Furthermore, a first measurement of the branching fraction of the $\psi(3770) \to p\bar{p}$.