APCTP Workshop on Nuclear Physics 2022: Physics of Excited Hadrons in the Present and Future Facilities

Monday, 11 July 2022 - Saturday, 16 July 2022

Jeju Suites Hotel

Programme

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Monday, 11 July 2022

Registration - Suite Hall (08:00 - 08:50)

Session: 1 - Suite Hall (08:50 - 10:20)

-Conveners: Oh, Yongseok (Kyungpook National University)

[10] Opening (08:50, 10 minutes)

[13] Nucleon Resonance Electrocouplings and Emergence of Hadron Mass (09:00, 40 minutes)

Presenter: MOKEEV, Victor (Thomas Jefferson National Accelerator Facility)

The emergence of hadron mass (EHM) represents one of the most challenging and still open problem in the Standard Model. The recent advances toward understanding EHM from the experimental results on the evolution of the nucleon resonance electrocouplings with photon virtuality Q^2 available from exclusive meson electroproduction data measured with the CLAS detector at JLab will be presented in this talk. A successful description of the $\Delta(1232)3/2^+$ and $N(1440)1/2^+$ electrocouplings has been achieved within the continuum Schwinger method (CSM) with the same momentum dependence of the dressed quark mass inferred from the QCD Lagrangian as used for the successful description of the pion and nucleon elastic electromagnetic form factors, and the pion PDF. The CSM predictions on the electrocouplings of the $\Delta(1600)3/2^+$ resonance from 2019 have been confirmed by the (still preliminary) experimental results determined from the CLAS $\pi^+ \pi^- p$ electroproduction data at $2.0<Q^2<5.0$ GeV^2 that have become available in the first half of 2022. All of these achievements in the synergistic efforts between experiment, phenomenology, and hadron structure theory clearly demonstrate the capability to gain insight into EHM from the studies of the nucleon resonance electrocouplings, combined with exploration of the ground state nucleon and pion/kaon structure within a common theory framework offered by CSM. Future extensions of these studies from the data of experiments of the 12 GeV era at JLab will allow us to address key open problems of the Standard Model on the nature of hadron mass and the emergence of hadron structure from QCD.

[12] Nucleon resonances/Pentaquark states in J/ψ photo-production reaction on the nucleon (09:40, 40 minutes)

Presenter: LEE, T.-S. H. (Argonne National Laboratory)

A dynamical model has been developed, following the ANL-Osaka approach, to investigate the J/ψ photo-production reaction on the nucleon. The photo-production mechanisms consists of the Pomeron-exchange and a phenomenological multi-gluon exchange calculated from Constituent quark model and J/ψ-N potential deduced from LQCD. The final state interactions include the coupled-channel effects due to the unitarity condition imposed by the pion-nucleon total cross sections data. The results are compared with the predictions from the models based on Perturbative QCD and Generalized Parton Distribution, and the Holographic model. The predictions for future JLab experiments will be presented. The recent applications of ANL-Osaka amplitudes to analyze the data of pion production on nuclei will also be briefly reported.

Break - Suite Hall (10:20 - 10:40)

Session: 2 - Suite Hall (10:40 - 12:00)

-Conveners: Sako, Hiroyuki (Japan Atomic Energy Agency)

[37] Polarized Structure Function $\sigma_{LT'}$ from π^0p Electroproduction Data in the Resonance Region (10:40, 40 minutes)

Presenter: KIM, Andrey (University of Connecticut)

The N* program in Jefferson Lab is crucial for understanding the strong interaction in non-perturbative regime and the emergence of hadron mass. Studies of resonance electroexcitation in Nπ electroproduction represent an important part of these efforts. The data on beam spin asymmetry provide unique information on the imaginary part of the interference terms between the electroproduction amplitudes with the longitudinally and transversely polarized virtual photons. The new CLAS results on beam spin asymmetry and polarized structure function $\sigma_{LT'}$ for π^0p electroproduction at invariant masses of the final hadrons from the threshold and up to 1.8 GeV and at photon virtualities $0.4 < Q^2 < 1.0$ GeV^2 will be presented in the talk. Analyses of these results demonstrated sensitivity of the Legendre moments of the $\sigma_{LT'}$ structure function to the electroexcitation amplitudes of the nucleon resonances in the mass range > 1.6 GeV. Combined studies of beam spin asymmetries and unpolarized cross sections for π^0p electroproduction channel will allow us to improve knowledge on Q^2-evolution of the resonance electroexcitation amplitudes, in particular, for the resonances in the third resonance region.

[6] Covariant quark model calculations of nucleon resonance transition form factors and more (11:20, 40 minutes)

Presenter: RAMALHO, Gilberto (Soongsil University)

In the last decades a significant progress have been made in the electroproduction of nucleon resonances $N^\ast$. Form factors associated to the $\gamma^\ast N \to N^\ast$ transition, where N is the nucleon, have been measured in different facilities, at low, intermediate, and large square momentum transfer, Q^2, for increasing values of the resonance mass. The new experimental data motivated the development of theoretical models which can be used at intermediate and large Q^2. One of these models is the covariant spectator quark model. In the first part of the presentation, we present a summary of the model calculations for several nucleon resonances, including the $\Delta(1232)$, $N(1440)$, $N(1535)$ and $N(1520)$ resonances. In the last part of the presentation, we discuss extensions of the formalism to baryons with strange quarks in the vacuum and in the nuclear medium.

Lunch - Suite Hall (12:00 - 14:00)

Free Time - Suite Hall (14:00 - 18:00)

Reception - La Taberna (18:30 - 20:00)

Tuesday, 12 July 2022

Session: 3 - Suite Hall (09:00 - 10:20)

-Conveners: Mokeev, Victor (Thomas Jefferson National Accelerator Facility)

[17] Physics Highlights and Perspectives with Electron Beams in Mainz (09:00, 40 minutes)

Presenter: ACHENBACH, Patrick (Johannes Gutenberg University Mainz)

The Mainz Microtron MAMI is an ideal facility to study the hadron structure with the electromagnetic probe. High-intensity polarized electron and photon beams with energies up to 1.6 GeV are delivered to several experimental halls. Polarized targets and recoil polarimeters in combination with dedicated detectors are available for precision experiments in hadron physics. Supplementary, the electron accelerator MESA (Mainz Energy-recovering Superconducting Accelerator) is under construction. Its operating principle of an energy-recovering linac is a key to precision physics. MESA will provide very high luminosities with nearly massless targets, thereby increasing the possible resolution of low energy electron scattering experiments by orders of magnitude. In this talk, highlights from the physics program will be presented.

[21] Studies of baryon resonances with meson beams at J-PARC (09:40, 40 minutes)

Presenter: SAKO, Hiroyuki (Japan Atomic Energy Agency)

In this presentation, we will show experimental plans to study nucleon resonances (N^* and Δ^*) using $\pi N \rightarrow \pi \pi N$ reactions (E45) and search for new $\Lambda(1665)$ resonance in $K^{-} p \rightarrow \Lambda \eta$ reaction (E72) at J-PARC Hadron Experimental Facility. These experiments will be performed using a large acceptance spectrometer based on a Time Projection Chamber (HypTPC). The high-intensity $\pi^{\pm}$ and K^{-} beams will be injected on the liquid hydrogen target which is embedded in the high-rate capable TPC. The TPC is placed inside a superconducting Helmholtz magnet. For E45, we will measure these reactions in small momentum steps in the center-of-mass energy range of 1.5-2.1 GeV. Then, we perform partial wave analysis to extract properties of resonances. For E72, we will search for $\Lambda(1665)$ resonane around $\sqrt{s}=1665$ MeV and determine its spin parity using angular dependence of the produced particles. In this presentation, we will show the experimental design, expected results in simulations, and the status of the detector development.

Break - Suite Hall (10:20 - 10:40)

Session: 4 - Suite Hall (10:40 - 12:00)

-Conveners: Hosaka, Atsushi (RCNP, Osaka University)

[9] Combined Analysis of Photo- and Electroproduction Reactions with the Julich-Bonn-Washington Model (10:40, 40 minutes)

Presenter: DOERING, Michael (The George Washington University)

Data on the photo- and electroproduction of different hadrons provide access to the spectrum of excited baryons and its properties. Recent results from the Julich-Bonn-Washington model will be presented, including extensions to the electroproduction of pions and η mesons, and to $K\Sigma$ photoproduction. The amplitudes and resonance properties obtained through this phenomenological analysis can serve as a point of comparison for theories and models of excited baryons and their dynamics. Connections to lattice QCD and opportunities with hadron beams will be briefly discussed, as well.

[16] Amplitude analysis and complete experiments for light baryon spectroscopy (11:20, 40 minutes)

Presenter: WUNDERLICH, Yannick (University of Bonn)

The talk will summarize the newly-obtained knowledge about the spectrum of light baryons, which has been attained in recent years with the help of coupled-channel partial-wave analyses. Then, further details will be given on new results and methods for the single-channel amplitude analyses of reactions involving particles with spin, to which the author has contributed directly. An outlook will be provided on the feasibility as well as the utility of (coupled-channels) complete experiments for baryon spectroscopy.

Lunch - Suite Hall (12:00 - 14:00)

Session: 5 - Suite Hall (14:00 - 15:20)

-Conveners: Choi, Ho-Meoyng (Kyungpook National University)

[2] Interaction between the eta meson and nucleus studied in coherent neutral-pion and eta-meson photoproduction on the deuteron (14:00, 40 minutes)

Presenter: ISHIKAWA, Takatsugu (Research Center for Electron Photon Science (ELPH), Tohoku University, Japan)

The interaction between an eta meson and a nucleus provides the in-medium modification of the eta meson and/or a chiral partner candidate of the nucleon $N(1535)1/2^-$, to which the eta meson and nucleon couples. We have studied such an interaction for the lightest nucleus, deuteron, from the measurement of cross sections for coherent neutral-pion and eta-meson photoproduction on the deuteron. We have found a narrow resonance-like bump in the eta-deuteron subsystem at the vicinity of the threshold, suggesting strong eta-deuteron attraction. The sharp backward-peaking angular dependence of deuteron emission, predicted by the existing theoretical calculations, does not appear. We discuss the possibilities of using coherent neutral-pion and eta-meson photoproduction on a nucleus to study the eta-nuclear interaction.

[26] Studies on the $K\Sigma$ bound-state via $K^+ p \to K^+ \phi p$ (14:40, 40 minutes)

Presenter: NAM, Seung-il (Pukyong National University)

In the present work, we investigate the hidden-strangeness production process in the $S=+1$ channel via $K^+ p \to K^+ \phi p$, focusing on the exotic pentaquark molecular $K^* \Sigma$ bound-state, assigned by $P_s^+(2071,3/2^-)$. For this purpose, we employ the effective Lagrangian approach in the tree-level Born approximation. Using the experimental and theoretical inputs for the exotic state and for the ground-state hadron interactions, the numerical results show a small but obvious peak structure from Ps+ with the signal-to-background ratio $\approx 1.7\%$, and it is enhanced in the backward-scattering region of the outgoing K^+ in the center-of-mass frame. We also find that the contribution from the $K^*(1680,1^-)$ meson plays an important role to reproduce the data. The proton-spin polarizations are taken into account to find a way to reduce the background. The effects of the possible 27-plet pentaquark Θ_{27}^{++} are discussed as well.

Break - Suite Hall (15:20 - 15:40)

Discussion: Partial Wave Analysis - Suite Hall (15:40 - 17:00)

-Conveners: Doering, Michael (The George Washington University); Mokeev, Victor (Thomas Jefferson National Accelerator Facility)

Wednesday, 13 July 2022

Session: 6 - Suite Hall (09:00 - 10:20)

-Conveners: Ji, Chueng-Ryong (North Carolina State University)

[22] Tetraquark bound and resonant states (09:00, 40 minutes)

Presenter: HOSAKA, Atsushi (RCNP, Osaka University)

We will report four-body study for tetraquarks of various flavor combinations including confining and scattering states. Properties of bound and resonant states are studied. Different structures of molecular or compact types emerge depending on how far the states are located from thresholds. Refs: Q. Meng et al, Phys.Lett.B 814 (2021) 136095; Phys.Lett.B 824 (2022) 136800

[25] Studies of excited baryons with heavy flavors at J-PARC (09:40, 40 minutes)

Presenter: NOUMI, HIroyuki (RCNP, Osaka University/INPS, KEK)

"How does QCD build hadrons?" is still an unanswered question in hadron physics. In particular, behaviors of the strong interaction in low energy is an issue, which are characterized by the spontaneous breaking of chiral symmetry and quark confinement. As a consequence, massive, constituent quarks, as effective degrees of freedom to describe hadrons, are emergent together with the so-called Nambu-Goldstone bosons. Spectroscopy of baryons with heavy flavors provides good opportunities to investigate dynamics of such effective degrees of freedom, through which the behaviors of non-trivial QCD vacuum in low energy are to be revealed. We are particularly interested in diquark correlations in baryons. The diquark correlation is expected by an attractive spin-spin interaction between two quarks with spin-parity 0+ and the attractive interaction is a source of the diquark condensate in highly dense quark matter. The origin of the spin-spin interaction betwen quarks is a longstading question, where the effect of the non-trivial gluon field such as the so-called instanton-induced interaction (Kobayashi-Maskawa-t'Hooft interaction) is an issue. We expect to disentangle the diquark correlations by introducing heavy flavors in baryons. I will discuss above-mentioned issues in baryon spectroscopy with heavy flavors to be conducted in the future facilities at J-PARC.

Break - Suite Hall (10:20 - 10:40)

Session: 7 - Suite Hall (10:40 - 12:00)

-Conveners: Ishikawa, Takatsugu (Research Center for Electron Photon Science (ELPH), Tohoku University)

[34] Electromagnetic interaction of baryon resonances in the timelike region studied via the reaction $\pi^+N \to Ne^+e^-$ (10:40, 40 minutes)

Presenter: ZÉTÉNYI, Miklós (Wigner RCP)

A very important contribution of dilepton production in pion-nucleon collisions comes from the Dalitz decay of s-channel baryon resonances, $R \to N e^+ e^-$. These dileptons originate from a virtual photon with small timelike squared four-momentum q^2, therefore the study of this reaction gives access to the electromagnetic interaction of baryon resonances in a kinematical domain inaccessible elsewhere. In this contribution, we discuss what space-time symmetries teach us about the anisotropy of dileptons in $\pi^+N \to Ne^+e^-$. Then we present an effective Lagrangian model and its predictions for the cross-section of the reaction. These predictions will be compared to recent experimental results obtained by the HADES collaboration in pion beam experiments at the CM energy of 1.49 GeV where baryons of the second resonant region are expected to give important contributions.

[5] High luminosity experiments in Hall A at Jefferson Laboratory (11:20, 40 minutes)

Presenter: CAMSONNE, Alexandre (Jefferson Laboratory)

I will present several running or approved high luminosity experiments planned in Hall A. I will also discuss possible new experiment using improved version of those setups in particularly Double Deeply Virtual Compton Scattering.

Lunch - Suite Hall (12:00 - 14:00)

Excursion (14:00 - 18:30)

Yacht Tour

Workshop Dinner - Suite Hall (18:30 - 20:30)

Thursday, 14 July 2022

Session: 8 - Suite Hall (09:00 - 10:20)

-Conveners: Cole, Philip (Lamar University)

[30] Physics with PANDA at FAIR (09:00, 40 minutes)

Presenter: BRINKMANN, Kai-Thomas (JLU Giessen, II. Physik)

The PANDA (Antiproton annihilations in Darmstadt) experiment at the Facility for Antiproton and Ion Research, FAIR, in Darmstadt, Germany, will address a variety of questions in hadron physics utilizing an antiproton beam of up to 15 GeV/c in momentum. The experiment is designed to work in the charmonium mass region, where recent experimental evidence found a plethora of states that are apparently incompatible with standard quark model interpretations. The detector system of PANDA is optimized to meet the challenges of high-resolution spectroscopy of charmonium states of any quantum number in formation and production with very good background suppression. High interaction rates and unprecedented momentum precision will thus facilitate key experiments in hidden and open charm spectroscopy. Furthermore, PANDA is designed for copious strangeness production. The hydrogen cluster jet and pellet targets of PANDA can be substituted by heavier targets, allowing for the investigation of meson production in nuclei and the interaction of mesons with the nuclear medium. The presentation will discuss the physics prospects of the many facets of the PANDA program as well as the status of the experimental equipment. The design of the detector components of PANDA, which will consist of a target solenoid and a forward dipole, is well advanced. Prototypes of all detector components have been subjected to beam tests, detectors are being prepared for early physics experiments. A status report on the detector components will be given and the physics reach of the full detector assembly will be underlined with studies in selected benchmark channels. Work supported by BMBF within the focus program ErUM-FSP T08 and HFHF. PANDA is supported by the national funding agencies of the participating groups.

[39] The BGOOD experiment at ELSA and multi-quark structures in the uds-sector * (09:40, 40 minutes)

Presenter: SCHMIEDEN, Hartmut (University of Bonn (PI))

The discovery of the X, Y, Z meson states first by Belle, and the P_C baryon states by LHCb revealed the existence of multi-quark objects beyond the simple quark-antiquark or 3-quark valence configurations in the (hidden) charm sector. If the emergence of such multi-quark structures was a general feature of QCD, then related structures should exhibit in the uds-sector as well. The BGOOD experiment at the ELSA electron accelerator of Bonn University is exactly devoted to investigate such possible baryonic structures in meson photoproduction. Particular attention is paid to threshold effects. I will discuss recent results which include the archetypal meson-baryon 5-quark hyperon Λ(1405), the hypothesised $N^*(2030/2080)$ as the strange-sector partners of the charm-sector $P_C(4380/4450)$ pentaquarks, and possible “hexaquark“ di-baryon configurations. *This project received funding from the DFG (Project no 50165297 and 405882627), from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 824093, and from the Land NRW.

Break - Suite Hall (10:20 - 10:40)

Session: 9 - Suite Hall (10:40 - 12:00)

-Conveners: Kim, Hyun-Chul (Inha University)

[23] Searching for exotics/hybrids in multi-pion photoproductions: focusing on tensor meson photoproduction (10:40, 40 minutes)

Presenter: YU, Byung-Geel (Korea Aerospace University)

In search of the possibility of exotics/hybrid states, we present the Regge description of photoproduction of axial meson as well as tensor meson from the recombination of photoproduction with multi pion in the final state as a single-particle process. Comparative analyses with experimental data are provided for further guidance in the investigation of possible hybrids in these photoproductions.

[8] Chiral anomaly and the pion properties in the light-front quark model (11:20, 40 minutes)

Presenter: CHOI, Ho-Meoyng (Kyungpook National University)

We explore the link between the chiral symmetry of QCD and the numerical results of the light-front quark model, analyzing both the two-point and three-point functions of the pion. Including the axial-vector coupling as well as the pseudoscalar coupling in the light-front quark model, we discuss the implication of the chiral anomaly in describing the pion decay constant, the pion-photon transition form factor and the electromagnetic form factor of the pion. In constraining the model parameters, we find that the chiral anomaly plays a critical role and the analysis of $F_{\pi\gamma}(Q^2)$ in timelike region is important. Our results indicate that the constituent quark picture is effective for the low and high Q^2 ranges implementing the quark mass evolution effect as Q^2 grows.

Lunch - Suite Hall (12:00 - 14:00)

Session: 10 - Suite Hall (14:00 - 15:20)

-Conveners: Schmieden, Hartmut (University of Bonn (PI))

[15] Inclusive electron scattering off the proton with CLAS12 (14:00, 40 minutes)

Presenter: HAYWARD, Timothy (University of Connecticut)

Electron scattering data off a proton target has been measured with the CLAS12 spectrometer in Hall B at Jefferson Laboratory in a wide kinematic range covering W up to 2.5 GeV and Q^2 up to 10 GeV^2. These results allow new opportunities to explore a wide range of physics including inclusive, semi-inclusive and fully exclusive reactions. Preliminary results aimed toward the extraction of the inclusive electroproduction cross section from CLAS12 data collected at a beam energy of 10.6 GeV from an unpolarized liquid-hydrogen target will be presented. The large acceptance and good PID of CLAS12 data offer a unique opportunity to measure the inclusive cross sections from the meson electroproduction threshold up to $W = 2.5$ GeV in many multidimensional bins of W and Q^2. The coverage in W and Q^2 is of particular importance for the extension of our knowledge of the nucleon parton distribution function from the data on the F_2 structure function in the resonance region from existing CLAS results on $\gamma p N^*$-electroexcitation amplitudes. These studies also offer valuable input for the exploration of quark-hadron duality

[18] $K^- p \to K \Xi$ reaction and Λ^* and Σ^* resonances (14:40, 40 minutes)

Presenter: KIM, Sangho (Soongsil University)

Multistrangeness baryons ($S < -1$) are important in our understanding of strong interactions and are expected to be observed more precisely in the future experiments, e.g., J-PARC, FAIR/GSI, and JLab. We investigate the reaction mechanism of $K^- p \to K \Xi$ based on the effective Lagrangian approach. In addition to the usual Born diagrams, the box diagrams are taken into account in detail. We find that a few Λ^* and Σ^* resonances are crucial in explaining the recent J-PARC data.

Break - Suite Hall (15:20 - 15:40)

Contributed Talks: A - Suite Hall (15:40 - 16:55)

-Conveners: Noumi, Hiroyuki (RCNP, Osaka University)

[4] Excited hadrons at Belle (II) experiment (15:40, 25 minutes)

Presenter: LI, Jin (Kyungpook National University)

We show recent results on excited hadrons at Belle (II) experiment. First, we discuss an observation of excited $S=-3$ hyperon ${\mathrm {\Omega } (2012) }^{-}$ and properties of $\Lambda(1670)$ and $\Sigma(1385)^+$ hyperons. In the analysis procedure, the importance of interplay between experiment and theory will be demonstrated. In addition, recent results on excited charmed baryons are shown, which include excited Λ_c, Σ_c and Ξ_c states. Finally, future prospects of study on excited hadrons in light and heavy sectors at Belle (II) will be presented.

[28] The axial-vector meson in the coupled-channel approach (16:05, 25 minutes)

Presenter: CLYMTON, Samson (Inha University)

We investigate meson resonances with quantum numbers $J^P=1^+$ and $S=0$ from the interaction of the pseudoscalar meson with the vector meson using the coupled-channel approach. Having included all possible one-meson exchange diagrams without an axial-vector meson one, we reproduce the experimental data on charge exchange reaction in a_1, h_1 and b_1 channels. This result exhibits the molecular nature of the axial-vector meson. In addition to that, we extract the pole position and residue of each resonance by scanning the scattering amplitudes in the second Riemann sheets.

[24] Un-binned Angular Analysis of $B\to D^*(D\pi)\ell\nu$ and C_{V_R} (16:30, 25 minutes)

Presenter: HUANG, Zhuoran (APCTP)

We perform a sensitivity study of an unbinned angular analysis of the $B\to D^*(D\pi)\ell\nu$ decay, including the contributions from the right-handed (R.H.) vector current. We show that the Wilson coefficient of the R.H. vector current can be strongly constrained by measuring the normalized angular observables $\langle g_i \rangle$ (i=1,2,...,11) without the intervention of the V_{cb} puzzle.

Friday, 15 July 2022

Session: 11 - Suite Hall (09:00 - 10:20)

-Conveners: Achenbach, Patrick (Johannes Gutenberg University Mainz)

[31] Towards mechanical properties of the proton (09:00, 40 minutes)

Presenter: BURKERT, Volker (Jefferson Laboratory)

The mechanical properties of the proton are encoded in the proton's matrix element of the energy-momentum tensor (EMT), and are expressed in the gravitational form factors (GFF) that represent the distribution of mass, shear stress, and angular momentum inside the proton. Another global quantity that can be obtained is the mechanical radius of the proton. The GFF can be directly probed only through interaction with spin-2 gravitons, a highly impractical proposition. However, the GFF can be probed indirectly through processes such as deeply virtual Compton scattering and time-like Compton scattering that involve spin-2 interactions due to the presence of two photons, one virtual photon (space-like or time-like), and one real photon coupling to the same quark in the proton. The current status will be briefly reviewed, and expected results on DVCS and TCS data from JLab@12 GeV will be discussed. A brief outlook at the EIC capabilities will be given.

[7] Light-Front Quark Model Analysis of Radially Excited Pseudo-scalar and Vector Mesons (09:40, 40 minutes)

Presenter: JI, Chueng-Ryong (North Carolina State University)

Light-Front Quark Model (LFQM) based on the QCD motivated effective Hamiltonian provides a consistent framework for the analysis of both the mass spectra and the wave-function related physical observables such as decay constants and electromagnetic form factors of hadrons. I will review the framework of LFQM and focus on the recent application on the radially excited pseudoscalar and vector meson analysis with the emphasis of the mixing effects between 1S and 2S heavy meson systems. Our result indicates that the newly discovered $D_{s0}(2590)^+$ meson in LHCb may be interpreted as a radial excitation of the D_s^+ meson.

Break - Suite Hall (10:20 - 10:40)

Session: 12 - Suite Hall (10:40 - 12:00)

-Conveners: Doering, Michael (The George Washington University)

[14] The structure of singly heavy baryons in a pion mean-field approach (10:40, 40 minutes)

Presenter: KIM, Hyun-Chul (Inha University)

In this talk, I review a series of recent works on the structure of singly heavy baryons in a pion mean-field approach or the chiral quark-soliton model. In the infinitely heavy-quark mass limit, a singly heavy baryon can be viewed as a bound state of the soliton with N_c-1 light valence quarks and a heavy quark as a static color source. The presence of the N_c-1 valence quarks produces the mean pion fields that interact with the valence quarks in a self-consistent manner. We perform a zero-mode quantization to get the collective Hamiltonian for the singly heavy baryons. Since the right hypercharge is constrained by the N_c-1 valence quarks, the flavor SU(3) irreducible representations of the baryon antitriplet and sextet appear naturally. Thus, the dynamics of the singly heavy baryons are governed by the light quarks. Considering the rotational $1/N_c$ and linear m_s corrections, we investigate various properties of the singly heavy baryons such as the mass spectrum, magnetic moments, and axial charges. We also study the quark spin content of the singly heavy baryon.

[19] Recent progress on radial excitation of hadron (11:20, 40 minutes)

Presenter: ARIFI, Ahmad Jafar (APCTP)

Understanding hadron spectrum emerging from QCD is one of the central issues in hadron physics. One of the challenging problems is to clarify the internal structure of the observed states whether they are conventional or exotic states. In this talk, I will review our recent activities to understand the excited states of hadron, including meson and baryon, within the chiral and light-front quark models. I will put an emphasis on the radial excitations that appear to follow flavor-independent hierarchies. Not only mass spectrum, but also other properties such as strong decay pattern, e.m. form factor, etc, will be discussed. We find that such a systematic study for various quark flavor contents provides useful constraints to their internal structure.

Lunch - Suite Hall (12:00 - 14:00)

Contributed Talks: B - Suite Hall (14:00 - 15:15)

-Conveners: Byung-Geel Yu

[33] The mass-radius relations of neutron stars in an pion mean-field approach (14:00, 25 minutes)

Presenter: GHIM, Nam-Yong (INHA University)

We investigate the masses and radii of neutron stars within the framework of the in-medium modified chiral soliton model, considering the effects of surrounding baryonic environment on the properties of in-medium baryons. The equation of state describing an infinite and asymmetric nuclear matter are obtained by introducing the density-dependent functions. To extrapolate the high density and highly isospin asymmetric region, we study the masses and radii of neutron stars. The results predict the masses and radii to be 1.4$M_{\bigodot}$ and 2$M_{\bigodot}$, respectively. We discuss the physical meaning of the equation of state obtained from the chiralsolitonic approach, based on the present results.

[3] Nuclear medium effects on distribution functions for spin-1 vector meson (14:25, 25 minutes)

Presenter: HUTAURUK, Parada Tobel Paraduan (Pukyong National University)

Medium modifications on the distribution functions of the spin-1 vector meson as well as its medium properties are investigated in the quark-level chiral effective theory of QCD. Nuclear medium effects are also obtained from the same chiral effective model. Remarkable results on the distribution functions and properties of vector meson in the nuclear medium will be presented and discussed.

[27] Transverse single-spin asymmetry of the neutral pion in the very forward direction (14:50, 25 minutes)

Presenter: KIM, Hee-Jin (Inha University)

We investigate the transverse single-spin asymmetry (TSSA) for the very forward neutral pion production by employing the triple-Regge exchanges. The TSSA is ratio of spin-dependent and spin-averaged differential cross section. In the RHICf energy($\sqrt{s}=510\,\mathrm{GeV}$), the inclusive $p+p^\uparrow\to\pi^0+X$ process will be diffractive, so that $d\sigma$ can be expressed in terms of the triple-Regge exchanges. Our numerical results are in a remarkable agreement with RHICf data. It indicates that A_N is of diffractive nature in the low p_T region.

Break - Suite Hall (15:15 - 15:35)

Contributed Talks: C - Suite Hall (15:35 - 16:50)

-Conveners: Jo, Hyon-Suk (Kyungpook National University)

[32] Instanton effects on charmonium spectrum and electromagnetic transitions (15:35, 25 minutes)

Presenter: HONG, Ki-Hoon (Inha University)

We investigate the mass spectrum and electromagnetic transitions of charmonia, emphasizing the instanton effects on them. The heavy-quark potential consists of the Coulomb-like potential from one-gluon exchange and the linear confining potential. We introduce the nonperturbative heavy-quark potential derived from the instanton vacuum. We also consider the screened confining potential, which better describes the electromagnetic decays of higher excited states. Using this improved heavy-quark potential, we compute the mass spectrum and electromagnetic decays of the charmonia and discuss the results.

[35] Gravitational form factors of the baryon octet and their stability conditions with flavor SU(3) symmetry breaking (16:00, 25 minutes)

Presenter: WON, Ho-Yeon (Inha university)

We investigate the gravitational form factors of the baryon octet within the framework of the chiral quark-soliton model, also known as the pion mean-field approach, emphasizing the effects of flavor SU(3) symmetry breaking on the form factors. The D-term form factors provide information on the stability conditions of the baryon octet in terms of the pressures and shear forces inside them. We show explicitly that the stability conditions are well preserved in the presence of flavor SU(3) symmetry breaking. We also discuss various physical implications of the gravitational form factors of the SU(3) baryon octet.

[29] Axial-vector transition form factors of singly heavy baryons in the chiral quark-soliton model (16:25, 25 minutes)

Presenter: SUH, JungMin (Inha University)

In the present talk, we present the axial-vector transition form factors of the lowest-lying heavy baryons within the framework of the chiral quark-soliton model. In the infinitely heavy quark mass limit, a heavy quark can be considered as a color static source. We consider the linear rotational $1/N_{c}$ and strange current quark mass corrections. The results of axial-vector transition form factors of singly heavy baryons are discussed in comparison with those of light baryons. The axial radius of a singly heavy baryon is larger than that of a light baryon.

Saturday, 16 July 2022

Session: 13 - Suite Hall (09:00 - 10:20)

-Conveners: Brinkmann, Kai-Thomas (JLU Giessen, II. Physik)

[38] Exploring the production of N^*s with pion and electron beams (09:00, 40 minutes)

Presenter: COLE, Philip (Lamar University)

The study of electromagnetic transitions opens a window into the very nature of the strong interaction. And, indeed, such a study of how a ground-state nucleon transitions to an excited state, over a broad range of q^2, will provide keen insight into the evolution of how dynamically-generated masses emerge from the asymptotically-free, nearly massless quarks of perturbative QCD as well as provide information on the ancillary effects from the meson-baryon cloud. The space-like ($q^2<0$) region has been explored more intensively, particularly at JLab, but efforts are well under way in studying the time-like ($q^2>0$) region with HADES at GSI. We further expect to collect data with J-PARC Experiment E45 in 2025 using the Hyperon Spectrometer in the K1.8 beamline. We initiated these discussions at the May 2017 ECT* workshop, which was titled *space-like and time-like electromagnetic baryonic transitions*. The ECT* workshop established the need and made the first steps towards a consistent description spanning the two kinematical regimes in q^2. This talk will continue the discussions of space-like and time-like baryonic transition form factors. The world’s data in the second and third resonance regimes are dominated by the electroproduction of N^*s. We will ultimately require a coupled-channel approach for properly ascertaining the complementary features and overlapping information in forming excited baryons through employing both pion beams and electron/photon beams. Such partial-wave analyses are especially relevant in the two-pion decay mode, where the pion-induced N^* data at these higher energies are, at best, sparse to altogether nonexistent. These studies will require the apt coordination and collaboration of experimental and theoretical groups in Asia, Europe, and North America.

[36] Transition GPDs off Proton with CLAS12 (09:40, 40 minutes)

Presenter: JOO, Kyungseon (University of Connecticut)

Transition GPDs off Proton with CLAS12

Break - Suite Hall (10:20 - 10:40)

Session: 14 - Suite Hall (10:40 - 12:00)

-Conveners: Joo, Kyungseon (University of Connecticut)

[11] The S matrices of elastic alpha-carbon-12 scattering at low energies in effective field theory (10:40, 40 minutes)

Presenter: ANDO, Shung-Ichi (Summon University)

The elastic α-^{12}C scattering at low energies for $l=0,1,2,3,4,5,6$ is studied in effective field theory. We discuss a construction of the S matrices of elastic α-^{12}C scattering in terms of the amplitudes of sub-threshold bound and resonant states of ^{16}O, which are calculated from the effective Lagrangian. Parameters appearing in the S matrices are fitted to the phase shift data below the p-^{15}N breakup threshold energy, and we find that the phase shifts are well described within the theory.

[40] Closing (11:20, 40 minutes)

Presenter: BURKERT, Volker (Jefferson Laboratory)

Summary of the workshop and closing remarks

Lunch - Suite Hall (12:00 - 14:00)