HK 32: Few-body physics

Time: Tuesday 14:00–15:45 Location: H-ZO 100

Group Report HK 32.1 Tu 14:00 H-ZO 100

Dynamics of 1S0 diproton formation in pp- and pd-collisions — •Yuriy Uzikov for the ANKE-Collaboration — JINR, LNP, Dubna, Russia

Quasi-binary reactions $AB \to \{pp\}_s C$ with formation of a proton pair at small excitation energy $E_{pp} = 0 - 3$ MeV, i.e. the $^1S_0$ diproton $\{pp\}_s$, at high transferred momenta can give more definite information on short-range NN-dynamics, as compared to very similar (in kinematics) reactions $AB \to dC$ with the final deuteron d. The reason is that the contribution of non-short range mechanisms related to excitation of the Δ-isobars in intermediate states is expected to be strongly suppressed for the $AB \to \{pp\}_s C$ reactions as compared to $AB \to dC$ due to isospin symmetry and conservation of angular momentum and parity. In contrast to the expected suppression of the $\Delta(1232)$, the cross sections of the reactions $pp \to \{pp\}_s \pi^0$ and $pp \to \{pp\}_s \gamma$ recently measured at ANKE-COSY in forward direction in the GeV region demonstrate prominent peaks in the Δ-isobar region. This observation would mean that the exected short-range effects (like high momentum component of the NN-wave function) are actually rather week in the reactions with the diproton. Calculations of the differential cross sections of the reactions $pd \to \{pp\}_s n$, $pp \to \{pp\}_s \pi^0$ and $pp \to \{pp\}_s \gamma$ are performed within the one-pion exchange model and are found to be in qualitative agreement with the ANKE-COSY data.

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HK 32.2 Tu 14:30 H-ZO 100

Parity-violating effects in $A = 3, 4$ systems — •Michele Viviani[1], Rocco Schiavilla[2], Alejandro Kievsky[1], Luca Girlanda[3], and Laura E. Marcucci[3] — [1]INFN, Sezione di Pisa, Pisa (Italy) — [2]ODU, Norfolk and JLAB, Newport News (USA) — [3]Phys. Dept., Pisa University, Pisa (Italy)

The parity-violating components of the nucleon-nucleon potential are studied in $A = 3, 4$ nucleon systems. In particular, we'll report the calculation of i) the neutron spin rotation in $\vec{n}$-d scattering, and ii) the longitudinal spin asymmetry in the reaction $\vec{n} + {}^3\mathrm{He} \to p + {}^3\mathrm{H}$. The scattering wave functions are obtained by means of the Kohn variational principle and the hyperspherical harmonic method. The calculations are performed using a number of different, latest-generation strong-interaction two- and three-nucleon potentials and the DDH or the new effective field theory models for the weak-interaction potential. These observables are expected to be dominated by the contribution of the long-range part of the parity-violating potential associated with pion exchange. Thus their measurements could provide a further constraint, complementary to that coming from measurements of the photon asymmetry in $\vec{n} - p$ radiative capture, on the strength of this component of the hadronic weak interaction.

HK 32.3 Tu 14:45 H-ZO 100

Study of three-nucleon force effects in $\vec{p} + d$ break-up at 135 MeV — •Mohammad Eslami-Kalantari — KVI, Groningen, The Netherlands — Yazd University, Yazd , Iran

Understanding the exact nature of the nuclear force is one of the long-standing questions in nuclear physics. Nowadays, the progress of exploring the nuclear force in both the theoretical and experimental fronts is remarkable. On the experimental side, high precision measurements provide large sets of data which allow a systematic study of physical phenomena such as the three-nucleon force (3NF), the Coulomb force, and relativistic effects for a large range of energies. From the theoretical side, different approaches such as Chiral-perturbation, partial wave analysis, and meson exchange potentials supply a detailed description of these phenomena.

High-precision measurements of the break-up proton-deuteron reaction have been performed in the past at KVI and elsewhere with the aim to study three-nucleon force effects. In the present work, we explored 3NF effects in the break-up scattering process by performing a measurement of vector analyzing powers and differential cross sections using a 135 MeV polarized-proton beam impinging on a liquid-deuterium target. For this study, we explored a new experimental set-up, Big Instrument for Nuclear-polarization Analysis, BINA, which covers almost the entire kinematic phase space of the break-up reaction. The results are interpreted with the help of state-of-the-art Faddeev calculations.

HK 32.4 Tu 15:00 H-ZO 100

A Study of all reaction channels in deuteron-deuteron scattering at 65 MeV/nucleon — •Ahmad Ramazani-Moghaddam-Arani — Kernfysisch Versneller Instituut, University of Groningen,Groningen, The Netherlands — Department of Physics, Faculty of Science, University of Kashan, Kashan, Iran

Few-nucleon systems can be used as fundamental laboratories for studying the details of the nuclear force effects. We performed a series of deuteron-deuteron scattering experiments at intermediate energies. The experiments exploited BINA and BBS experimental setups and polarized deuteron beams with kinetic energies of 65 and 90 MeV/nucleon. These experiments aim to measure differential cross sections, vector and tensor analyzing powers of all available reaction channels in deuteron-deuteron scattering. With these data we will provide a systematic database, which will be used to test present theoretical approximations and upcoming ab-initio calculations in four-nucleon system.

The analysis procedure along with the latest results of the elastic and three-body break-up channels will be presented.

HK 32.5 Tu 15:15 H-ZO 100

photodisintegration of ^3H in a three dimensional Faddeev approach — shahriar bayegan, •mehdi ahmadian shalchi, and mohammad reza hadizadeh — Department of Physics, University of Tehran, P.O.Box 14395-547, Tehran, Iran

An interaction of a photon with ^3H nuclei is investigated based on a three dimensional Faddeev approach. In this approach The three-nucleon Faddeev equations with two-nucleon interactions are formulated with consideration of the magnitudes of the vector Jacobi momenta and the angle between them with the inclusion of the spin-isospin quantum numbers, without employing a partial wave decomposition. In this calculation the two body t matrices and triton wave function with nd scattering are calculated in the three dimensional approach using AV18 potential. The standard single nucleon current and π-and ρ-like two-body currents have been used which fulfill the current continuity equation together with the corresponding parts of the AV18 potential. Finally the calculated observables are compared with the results of partial wave one and the experimental data.

[1] J. Golak et.al. Phys.Rept. 415 (2005) 89-205

[2] S. Bayegan et.al. Phys.rev.C77:064005,2008

HK 32.6 Tu 15:30 H-ZO 100

few-body bound states in a three dimensional approach — •Mohammadreza Hadizadeh and Shahriar Bayegan — Department of Physics, University of Tehran, P.O.Box 14395-547, Tehran, Iran

Recently the three dimensional (3D) approach has been successfully applied for three- and four-body bound states [1-4], where it greatly simplifies the numerical calculations without using the PW decomposition. The Faddeev-Yakubovsky equations with two- and three-nucleon interactions are formulated as a function of the vector Jacobi momenta. This formalism, according to the number of spin-isospin states that one takes into account, leads to only a strictly finite number of coupled three dimensional integral equations to be solved. The evaluation of the transition and permutation operators as well as the coordinate transformations due to considering the continuous angle variables instead of the discrete angular momentum quantum numbers is less complicated in comparison with partial wave representation. With respect to the partial wave representation the 3D formalism with the smaller number of equations leads to higher dimensionality of the integral equations.

[1] M. R. Hadizadeh and S. Bayegan, Few Body Syst. **40**, 171 (2007).

[2] M. R. Hadizadeh and S. Bayegan, Eur. Phys. J. A **36**, 201 (2008).

[3] S. Bayegan, M. R. Hadizadeh, and M. Harzchi, Phys. Rev. C **77**, 064005 (2008).

[4] S. Bayegan, M. R. Hadizadeh, and W. Glöckle, to appear in Progr. Theor. Phys. **120**, (2008). arXiv:0806.1520