HK 49: Nuclear Structure and Dynamics II

Time: Wednesday 14:00–16:00 Location: H-ZO 50

Group Report HK 49.1 We 14:00 H-ZO 50

Hypernuclear Spectroscopy with Heavy Ion Beams: The HypHI project at GSI and towards FAIR — Take Saito, Sebastien Bianchin, Olga Borodina, Shizu Minami, Daisuke Nakajima, Banu Oezel, and •Christophe Rappold for the HypHI-Collaboration — GSI, Darmstadt, Germany

Until recently hypernuclei have been mainly studied via induced reactions of meson- or electron-beams on stable target materials, therefore the isospin of the produced hypernuclei is close to that of the target nucleus. In heavy ion collisions, hyperons are produced in the participant region and can be coalesced in the projectile fragment forming a hypernucleus in the projectile rapidity region. Isospin of the produced hypernucleus is widely distributed due to the nature of fragmentation reactions, therefore, this production method gives an opportunity to study neutron or proton rich hypernuclei. Furthermore, with this method, the produced hypernuclei can be separated and their magnetic moments can be measured for the first time.

The HypHI collaboration aims to perform precise hypernuclear spectroscopy with stable heavy ion beams and rare isotope beams at GSI and FAIR. We are currently preparing for the first experiment (Phase 0) planned in 2009 with ^{6}Li beams at 2 A GeV impinged on a carbon target to demonstrate the feasibility of the precise hypernuclear spectroscopy by identifying light hypernuclei mainly such as $^{3}_{\Lambda}$H, $^{4}_{\Lambda}$H and $^{5}_{\Lambda}$He. In the presentation, an overview of the HypHI project and the detail of the Phase 0 experiment will be discussed.

HK 49.2 We 14:30 H-ZO 50

Formation of hypernuclei in reactions induced by heavy-ion and hadron beams — •Theodoros Gaitanos, Horst Lenske, and Ulrich Mosel — Institut für Theoretische Physik, Universität Giessen, Germany

The formation of fragments with strangeness degrees of freedom (hypernuclei) within the GiBUU dynamical transport model combined with a statistical multifragmentation model (SMM) is investigated in reactions induced by high energy heavy-ion and hadron beams. Such reactions, which will be experimentally studied by the HypHI and PANDA collaborations at the FAIR facility at GSI, are especially well suited for the production of single and double strangeness hypernuclei allowing to study the nucleon-hyperon and hyperon-hyperon interactions. A detailed discussion on the applicability and limitations of the theoretical model are given. In particular, improvements of the present transport approach with respect to a better combination with statistical models of fragmentation and a better overall baryon dynamics at relativistic energies are investigated. Finally, theoretical predictions on spectra and inclusive cross sections of single $^{A}_{\Lambda}X$ and double $^{A}_{\Lambda\Lambda}X$ hypernuclei (X = H, He) in spectator fragmentation in reactions induced by light heavy-ion beams (^{12}C+^{12}C at 2AGeV) and high energy hadron beams are presented. The results are relevant for planning future experiments on hypernuclear physics at the new GSI- and J-PARC-facilities.
Work supported by BMBF.

HK 49.3 We 14:45 H-ZO 50

Pion induced production of hypernuclei — •Stefan Bender[1], Horst Lenske[1], Ulrich Mosel[1], and Radhey Shyam[2] — [1]Institut für Theoretische Physik, Universität Giessen, Germany — [2]Saha Institute of Nuclear Physics, Kolkata, India

We investigate strangeness production in coherent pion-nucleus reactions, in particular the production of Λ-hypernuclei. The interactions of the incoming and outgoing particles with the target nucleus are described by realistic pion-nucleus and kaon-nucleus potentials, respectively. We describe the transition to the $\bar{K}\Lambda$ channel with a field-theoretical resonance model, which has already been successfully applied to calculate proton induced production of hypernuclei. The Λ bound states as well as the in-medium interactions are calculated in fully relativistic models. Results for cross sections on various nuclear targets are discussed. Optical potentials are discussed and distortion effects are investigated by DWBA and eikonal methods. The characteristic dependence of the shape of the angular distribution on the angular momentum of the orbital which is populated by the Λ provides important information on the spectroscopy of the final hypernucleus.

HK 49.4 We 15:00 H-ZO 50

Dynamics of Nuclei with Antikaons — •Daniel Gazda[1], Jiří Mareš[1], Avraham Gal[2], and Eli Friedman[2] — [1]Nuclear Physics Institute, 25068, Řež, Czech Republic — [2]Racah Institute of Physics, The Hebrew University, Jerusalem 91904, Israel

We explore dynamical effects for $\bar{K}$ nuclear states using the relativistic mean-field approach [1]. Our main objective is to place lower limits on the width resulting from the $\bar{K}$ absorption in the nuclear medium. $\bar{K}$ absorption modes are included within an optical-model phenomenology, where the density ρ plays a dynamical role. A lower limit $\Gamma_{\bar{K}}$=50±10 MeV is placed on the widths of $\bar{K}$ nuclear states for binding in the range $B_{\bar{K}}$∼100-200 MeV [2]. Substantial polarization of the core nucleus is found in light kaonic nuclei, with central nuclear densities about twice higher than for the corresponding nuclei without $\bar{K}$. Calculations of multi-$\bar{K}$ nuclei indicate that the $\bar{K}$ separation energy, as well as the associated nuclear densities, saturate with the number of $\bar{K}$ mesons embedded in the nuclear medium. It is thus argued that multi-$\bar{K}$ nuclei do not compete with multihyperonic nuclei in providing the ground state of strange hadronic configurations and that kaon condensation is unlikely to occur in strong-interaction self-bound strange hadronic matter [3].
[1] J. Mareš, E. Friedman, A. Gal, Nucl. Phys. A 770, 84 (2006).
[2] D. Gazda, E. Friedman, A. Gal, J. Mareš, Phys. Rev. C 76, 055204 (2007); erratum - ibid. C 77 019904 (2008).
[3] D. Gazda, E. Friedman, A. Gal, J. Mareš, Phys. Rev. C 77, 045206 (2008).

HK 49.5 We 15:15 H-ZO 50

Annihilation cross-sections of verylow energy antiprotons on nuclei — Maurizio Corradini[1,2], Masaki Hori[3,4,5], Marco Leali[1,2], Evandro Lodi Rizzini[1,2], Valerio Mascagna[1,2], Aldo Mozzanica[1,2], Michela Prest[6,7], Erik Vallazza[6,7], •Luca Venturelli[1,2], and Nicola Zurlo[1,2] — [1]Dipartimento di Chimica e Fisica per l'Ingegneria e per i Materiali, Università di Brescia, I-25133 Brescia, Italy — [2]Istituto Nazionale di Fisica Nucleare, Gruppo Collegato di Brescia, I-25133 Brescia, Italy — [3]Max-Planck-Institut fur Quantenoptik, Hans-Kopfermann-Strasse 1, D-85748 Garching, Germany — [4]Department of Physics, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan — [5]CERN, CH-1211 Geneva 23, Switzerland — [6]Dipartimento di Scienze Fisiche e Matematiche, Università di Como, I-22100 Como,Italy — [7]Istituto Nazionale di Fisica Nucleare, Sezione di Trieste, I-34127 Trieste, Italy

The nuclear physics program of the ASACUSA Experiment at CERN concerns measuraments of antiproton-nuclei cross sections at low energies from MeV down to keV region. The importance of the results lies in the possibility to contribute in the understanding of the dynamic of annihilation process and to shed ligth on the saturation effect seen by the OBELIX Collaboration at 1-2 MeV where the annihilation rates od antiprotons on light nuclei (H, D, He) appear to be independent from the sizes of the targets.

The measurements performed by ASACUSA in 2008 with 5 MeV antiprotons on solid targets are reported and the trend with the mass number discussed.

HK 49.6 We 15:30 H-ZO 50

Lambda-Sigma Mixing in Nuclear Matter — •Christoph Valentin, Andreas Fedoseew, Patrick Konrad, and Horst Lenske — Institut für Theoretische Physik, Universität Giessen, Germany

We study the mixing of Lambda and Sigma baryons in asymmetric nuclear matter. Starting with a relativistic energy-density functional Lambda-Sigma-Mixing occurs as a many-body effect in isospin asymmetric systems generated by a non-diagonal self-energy in the medium. We describe our system in a density dependent relativistic hadron (DDRH) field theory with microscopically derived meson exchange interactions. For the hyperons we use coupling constants derived from NN-interactions by a scaling law. Our aim is to get a better understanding of the behavior of hyperons in asymmetric nuclear matter, neutron stars and finite nuclei. As an interesting result we find that the mixing is strongly enhanced with increasing asymmetry.

HK 49.7 We 15:45 H-ZO 50

Correlations in exotic nuclear matter — •Patrick Konrad and Horst Lenske — Institut für Theoretische Physik, Universität Giessen, Germany

We investigate short range correlations in asymmetric nuclear and hypernuclear matter. Self-energies due to short range correlations and their influence on the nucleon and Λ-hyperon spectral functions are described in an approach accounting for a realistic treatment of mean-field dynamics by a phenomenological Skyrme energy density functional. Landau-Migdal theory is used to derived the short range interaction from the Skyrme energy density functional, especially investigating short-range dynamics by subtracting the long range pionic contributions to the nucleonic spectral functions. The sensitivity of correlations on the parameters of underlying Skyrme energy density functional is discussed. Results on self-energies and spectral functions in asymmetric nuclear matter, hypermatter and β-stable (Λ, n, p, e)-neutron star matter are presented.
Work supported by GSI and BMBF.