

HK 31 Elektromagnetische und Hadronische Proben

Zeit: Dienstag 16:30–19:00

Raum: TU MA004

HK 31.1 Di 16:30 TU MA004

Total cross section of the $\pi^-p \rightarrow \pi^0n$ charge exchange reaction

— ●J. BREITSCHOPF¹, M. BAUER¹, H. CLEMENT¹, M. CRÖNI¹, H. DENZ¹, E. FRIEDMAN², E. GIBSON³, P. JESINGER¹, R. MEIER¹, and G. J. WAGNER¹ — ¹Physikalisches Institut, Universität Tübingen — ²Racah Institute of Physics, The Hebrew University, Jerusalem, Israel — ³California State University, Sacramento, USA

The origin of isospin violation in the strong interaction is the mass difference of the up- and down-quarks. Pion-nucleon elastic scattering and single charge exchange (SCX) offers access to the amount of isospin breaking. Recent analyses of existing data have found unexpectedly large (7%) violations for pion energies around 50 MeV. However, these analyses are probably affected by the limited SCX data base.

Therefore, we have measured total $\pi^-p \rightarrow \pi^0n$ cross sections at PSI in the energy range between 30 and 250 MeV with an accuracy of about 2%. We used a 4π scintillator box to measure the transmission of negatively charged pions through accurately manufactured CH_2 and C targets of about 4 mm thickness. The difference of the transmissions corresponds to reactions on hydrogen with outgoing neutral particles and yields the SCX cross sections. Non-vanishing detector sensitivities for photons and neutrons, effects of detector geometry, radiative pion capture pion decay *etc* lead to corrections of up to 8%. These were determined by extensive Monte Carlo simulations. Data were recorded event by event yielding about 2.5 TB of data. Experiment, data analysis and results will be presented and discussed.

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HK 31.2 Di 16:45 TU MA004

In Search of the Nature of the $\gamma\gamma$ Line at $2m_\pi$ in $pp \rightarrow pp\gamma\gamma$ and its relation to $\pi\pi$ Production * — ●M. BASHKANOV, H. CLEMENT, E. DOROSHEVICH, M. KASKULOV, O. KHAKIMOVA, F. KREN, R. MEIER, T. SKORODKO, and G. J. WAGNER for the CELSIUS-WASA collaboration — Physikalisches Institut, Universität Tübingen

At CELSIUS-WASA pp collisions with the emission of $\gamma\gamma$, π , $\pi\pi$, η have been measured exclusively with 4 to 6 overconstraints. In the $M_{\gamma\gamma}$ spectrum a small, narrow line has been observed at $M_{\gamma\gamma} = 2m_\pi$. In search of the nature of this line we have investigated a variety of scenarios. Aside from the possibility that this line is real, the only realistic alternative is a scenario, where γ s originating from $\pi^0\pi^0$ production merge into common γ clusters. This merger scenario is only effective if the π^0 s move parallel, i.e., $M_{\pi^0\pi^0} \approx 2m_{\pi^0}$. A peculiar enhancement is indeed observed in $M_{\pi^0\pi^0}$ right at threshold. However, reconstruction of the $\pi^0\pi^0$ parent spectrum by MC simulations in the merger scenario leads to the postulate of a threshold enhancement in $M_{\pi^0\pi^0}$, which is an order of magnitude larger than the actual observed one. In order to shed more light onto this problem we have investigated $pd \rightarrow {}^3He\pi\pi$ along with its $\gamma\gamma$ channel. In $M_{\pi^0\pi^0}$ we again find a threshold enhancement, which is even much larger than in pp collisions. Since in all cases the $M_{\pi^+\pi^-}$ spectra behave normal, these observations indicate a strong isospin breaking between $\pi^0\pi^0$ and $\pi^+\pi^-$ thresholds. We investigate the possibility that both observations in $M_{\pi^0\pi^0}$ and $M_{\gamma\gamma}$ are related by a dynamic σ .

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HK 31.3 Di 17:00 TU MA004

Two-Pion Production and the Question of Isospin Breaking and/or Bose-Einstein correlations * — ●T. SKORODKO, M. BASHKANOV, H. CLEMENT, E. DOROSHEVICH, M. KASKULOV, O. KHAKIMOVA, F. KREN, R. MEIER, and G. J. WAGNER for the CELSIUS-WASA collaboration — Physikalisches Institut, Universität Tübingen

The $\pi\pi$ production in pp collisions has been measured at CELSIUS in the energy range $T_p = 775 - 1360$ MeV exclusively using the WASA 4π detector with hydrogen pellet target. At energies close to threshold the data on the $pp\pi^+\pi^-$ channel can be well described by either the Roper resonance concept or a dynamic formation of the σ meson. At higher energy the formation of the $\Delta\Delta$ system becomes increasingly dominant. In particular the data are consistent with the special configuration $(\Delta\Delta)_{0+}$. The $pp\pi^0\pi^0$ channel basically shows a very similar behavior as expected from isospin invariance. However, $M_{\pi^0\pi^0}$ shows systematically an enhancement at small invariant masses. The deduced correlation function resembles

very much that for Bose-Einstein correlations (BEC). Alternatively the observed enhancements could be indicative of a (dynamic) isospin breaking possibly due to $\pi\pi$ rescattering in the σ channel. In order to discriminate both scenarios we have investigated also $pd \rightarrow {}^3He\pi\pi$. In contrast to $M_{\pi^+\pi^-}$, $M_{\pi^0\pi^0}$ exhibits again a strong enhancement at low masses, this time even substantially larger than 2, the BEC limit, favoring thus an isospin breaking scenario for the observed effects.

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HK 31.4 Di 17:15 TU MA004

Kommentare über die Isospinsymmetrie — ●HARTMUT MACHNER — Institut für Kernphysik, FZ Jülich

Der Isospin ist in Kernen nur eine ungefähre Symmetrie. Im Gegensatz dazu ist er in der Teilchenphysik eine nahezu erhaltene Symmetrie. Symmetriebrechung erfolgt durch die Coulomb-Kraft und den Massenunterschied zwischen den up- und down-Quarks. Der erste Grund ist dominant in Kernen. Der zweite Grund eröffnet die Möglichkeit den Massenunterschied zu messen. Eine Möglichkeit ist nach Isospin-Verletzungen in Reaktionen zu suchen. Wir diskutieren die Observablen am Beispiel von π^0 - und π^+ -Produktion in Nukleon-Nukleon- und Nukleon-Deuteron-Wechselwirkungen.

HK 31.5 Di 17:30 TU MA004

Study of the deuteron breakup $pd \rightarrow (pp)n$ at high momentum transfer at ANKE/COSY * — ●SERGEY YASCHENKO for the ANKE collaboration — Universität Erlangen-Nürnberg, Germany

The deuteron-breakup reaction $pd \rightarrow ppn$ at GeV projectile energies with emission of a fast forward diproton provides a new tool to investigate the pd dynamics at high-momentum transfer. The ANKE spectrometer at COSY-Jülich is well suited to obtain new data, e.g. the cross section and polarization observables in the $\bar{p}d \rightarrow (pp)n$ reaction, which should allow one to gain more insight into systems composed of more than two nucleons.

Recently, measurements of the unpolarized differential cross section at energies $T_p = 0.6, 0.7, 0.8, 0.95, 1.35,$ and 1.9 GeV and the vector analyzing power A_y at $T_p = 0.5$ and 0.8 GeV in the deuteron breakup were carried out. The results were compared with calculations based on a theoretical model taking into account one-nucleon exchange, single scattering, and Δ excitation in the intermediate state. Employing the high precision CD-Bonn potential this model describes fairly well the energy dependence of the unpolarized cross section and the analyzing power at 0.8 GeV, it fails to reproduce A_y at 0.5 GeV.

At present, data with high statistics at $T_p = 0.5, 0.8, 1.1, 1.4,$ and 2.0 GeV are being analyzed. The current status of the data analysis, preliminary results on differential cross sections in comparison with theoretical predictions and the plans for future measurements are presented.

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HK 31.6 Di 17:45 TU MA004

Investigation of the $a_0(980)/f_0(980)$ -resonances with ANKE at COSY * — ●ALEXEY DZYUBA¹, MARKUS BÜSCHER², VERA KLEBER³, and VLADIMIR KOPTEV¹ for the ANKE collaboration — ¹Petersburg Nuclear Physics Institut, Gatchina, Russia — ²Institut für Kernphysik, Forschungszentrum Jülich — ³Institut für Kernphysik, Universität zu Köln

The production of the lightest scalar resonances $a_0(980)$ and $f_0(980)$ in hadronic interaction is being investigated with the ANKE spectrometer, where their decays into $K\bar{K}$ can be observed. Final goal of these studies, which will be later supplemented by measurements of the non-strange decays with the WASA detector, is to learn about the nature of these states, about isospin violating processes in the a_0/f_0 system, FSI effects between antikaons and light nuclei. In this talk results of the data analysis for the reaction $pp \rightarrow da_0^+ \rightarrow dK^+\bar{K}^0$ measured at a beam energy $T_p = 2.83$ GeV will be presented. Total cross-sections, invariant-mass and angular distributions will be shown and compared with theoretical predictions. Preliminary results from our beam times aiming at a_0/f_0 production in the reactions $pn \rightarrow da_0^0/f_0 \rightarrow dK^+K^-$ and $dd \rightarrow \alpha f_0 \rightarrow \alpha K^+K^-$ will also be discussed. * supported by FZJ, DFG, BMBF, RFFI

HK 31.7 Di 18:00 TU MA004

Exclusive Measurements of the $\bar{p}p \rightarrow pp\pi^+\pi^-$ Reaction at COSY-TOF* — ●A. ERHARDT, K. EHRHARDT, K. HAUG, H. CLEMENT, E. DOROSHEVICH, and G. J. WAGNER for the COSY-TOF collaboration — Physikalisches Institut, Universität Tübingen

By use of the COSY vector polarized proton beam the $\bar{p}p \rightarrow pp\pi^+\pi^-$ reaction has been measured at COSY-TOF at two different energies, $T_p = 750$ and 800 MeV, i.e. close to threshold. Time-of-flight information and track reconstruction has been obtained by use of the informations supplied by start, fiber, quirl and ring hodoscopes, whereas particle identification and energy information has been provided by the central calorimeter. In addition, the delayed pulse technique has been utilized for a positive identification of π^+ particles. The dominant part of the extracted data samples consists of completely measured four-prong events, i.e. exclusively measured events with four overconstraints each. The resulting differential spectra for invariant masses, angular distributions and analyzing powers will be presented and discussed with respect to σ meson production and/or Roper excitation and their decay. * supported by BMBF (06 TU 201), DFG (Europ. Graduiertenkolleg), FZ Jülich (FFE) and Landesforschungsschwerpunkt (Quasiteilchen)

HK 31.8 Di 18:15 TU MA004

Deuteron Polarimetry at ANKE-COSY — ●D. CHILADZE^{1,2}, A. KACHARAVA^{3,2}, F. RATHMANN¹, and C. WILKIN⁴ for the ANKE collaboration — ¹IKP, FZJ, Germany — ²HEPI TSU, Tbilisi, Georgia — ³PI II, Universität Erlangen-Nürnberg, Germany — ⁴UCL, London, England

Nuclear reactions induced by beams of 1.2 GeV vector and tensor polarised deuterons incident on a hydrogen cluster target have been studied in a test experiment at the ANKE magnetic spectrometer situated inside the storage ring COSY-Jülich. By measuring precisely the momenta of one or two charged final particles, it was possible to identify clearly the processes $\vec{d}p \rightarrow dp$, $\vec{d}p \rightarrow dp_{sp}\pi^0$ (with a spectator proton p_{sp}), $\vec{d}p \rightarrow {}^3\text{He}\pi^0$, and $\vec{d}p \rightarrow (2p)n$, which all have large and well determined analyzing powers. The analysis of these data, which allowed us to extract values of the vector and tensor polarisations of the beam, will be presented. The aim of our experimental programme is the direct reconstruction of the spin-dependent amplitudes, including relative phases, of large angle neutron-proton elastic scattering through the study of the $\vec{p}(\vec{d}, 2p)n$ charge-exchange reaction. This work is supported by the FZJ.

HK 31.9 Di 18:30 TU MA004

Experimental search for Kaonic Nuclear Clusters in p+d @Tp=4.5GeV reaction at FOPI/GSI — ●KEN SUZUKI¹, LAURA FABBETTI¹, NORBERT HERRMANN², PAUL KIENLE^{1,3}, TOSHIMITSU YAMAZAKI⁴, and JOHANN ZMESKAL³ for the FOPI Collaboration collaboration — ¹Physik Department E12, TU-München — ²GSI — ³Stefan Meyer Institut of the Austrian Academy of Sciences — ⁴RIKEN

Recently, strongly bound \bar{K} nuclear systems have been predicted, which are shown to have large binding energies about 100 MeV for single- \bar{K} systems and 200 MeV for double- \bar{K} systems, and consequently they have large nucleon densities. Such systems will open a new paradigm for studying unusual quark-gluon structure in dense, cold and microscopic nuclear systems, in context to chiral symmetry restoration, hadron masses, kaon condensation and strange matter. We present here an experimental program and simulation results to search for the most elementary \bar{K} cluster system, ppK^- , in a p+d @ Tp=4.5GeV reaction with the FOPI apparatus at GSI, which will take place in the middle of next year. This work is supported by GSI.

HK 31.10 Di 18:45 TU MA004

Produktion von e^+e^- -Paaren in pp und pd Reaktionen* — ●B. SAILER¹, T. EBERL¹, L. FABBETTI¹, J. FRIESE¹, I. FRÖHLICH², J. PIETRASZKO³, W. PRZYGODA⁴ und S. SPATARO⁵ für die HADES-Kollaboration — ¹Technische Universität München, Physikdepartment E12 — ²Justus Liebig Universität Giessen, II. Physikalisches Institut — ³Gesellschaft für Schwerionenforschung mbH, Darmstadt — ⁴Jagiellonian University, Cracow — ⁵INFN Laboratori Nazionali del Sud, Catania

Mit dem HADES Detektorsystem wird bei der GSI (Darmstadt) die e^+e^- -Paarproduktion im invarianten Massenbereich bis $1.2\text{GeV}/c^2$ sowohl in Schwerionenstößen als auch in elementaren Reaktionen untersucht. Die Wirkungsquerschnitte für Mesonen- und Resonanzproduktion in p -induzierten Reaktionen am Nukleon sind z.T. sehr gut bekannt. Die Messung ihrer e^+e^- -Zerfälle dient daher sowohl zur Bestimmung der Gesamteffizienz von Detektorsystem und Analysesoftware als auch

zum systematischen Vergleich mit Resultaten aus $p + A$ und $A + A$ Reaktionen. Zur Vorbereitung geplanter und Interpretation bereits durchgeführter Messungen mit HADES haben wir ausführliche Simulationen der e^+e^- -Produktion für $p + p$ und $p + d$ im Energiebereich zwischen $E = 1.25 - 3.5$ GeV durchgeführt. Wir berichten Ergebnisse für verschiedene Ereignisgeneratoren (BUU, PLUTO++) und vollständiger Nachbildung des Detektorsystems (GEANT). Wir vergleichen dies mit den Ergebnissen erster Experimente. * gefördert durch BMBF (06MT190) und GSI (TM-KR2).