

## HK 25: Hadronenstruktur und -spektroskopie V

Zeit: Dienstag 16:30–19:00

Raum: HG III

HK 25.1 Di 16:30 HG III

**Central Production in the four charged pion channel at the COMPASS experiment** — ●JOHANNES BERNHARD for the COMPASS-Collaboration — Institut für Kernphysik, 55099 Mainz

The COMPASS experiment focused its physics program recently on light meson spectroscopy. As a fixed target experiment at the CERN SPS accelerator, COMPASS features large acceptance and high momentum resolution and thus qualifies well for studies of diffractive dissociation and central production. Meson formation with both a 190 GeV  $\pi^-$  and a 190 GeV proton/ $\pi^+$  beam on liquid hydrogen, lead and copper was studied in 2008 and 2009. Centrally produced final states inhere the possibility to concentrate on glue-rich resonances and glueballs. The exploration of final states with four charged pions is well suited to search for such objects, and will help to introduce new arguments in the long-standing discussion.

In this talk we will present the status of all activities at COMPASS concerning centrally produced pionic final state events and ideas of their treatment in a dedicated partial wave analysis as well as first preliminary results.

*supported by the BMBF*

HK 25.2 Di 16:45 HG III

**Study of the  $pd \rightarrow pdX$  reaction in the ABC-effect region** — ●TATIANA AZARYAN for the ANKE-Collaboration — JINR, Dubna, Russia

The ABC effect which is a low-mass enhancement in the pion-pion invariant mass spectrum, first observed by Abashian, Booth and Crow, is still not clearly understood.

The reaction  $p + d \rightarrow p + d + X$  was investigated at COSY-ANKE, Juelich at four proton beam energies: 0.8, 1.1, 1.4 and 2.0 GeV. Here we present the results obtained for two-pion production in a region traditionally referred to the ABC region. We observe a strong enhancement of the two-pion invariant mass spectrum close to the production threshold. In our measurements the final proton and deuteron were detected, and the 4-momentum of the unobserved particle(s) was reconstructed. In this inclusive reaction the proton and deuteron momenta have been measured at angles close to 0 degree (from 0 up to 15 degree). One should note that the kinematical conditions in our case are very different from other studies of the ABC-effect.

HK 25.3 Di 17:00 HG III

**Baryon Spectroscopy in COMPASS** — ●ALEXANDER AUSTREGILO, SUH-URK CHUNG, BERNHARD KETZER, SEBASTIAN NEUBERT, and STEPHAN PAUL for the COMPASS-Collaboration — Technische Universität München, Physik Department E18, D-85748 Garching

COMPASS is a fixed-target experiment at CERN SPS which investigates the structure and spectroscopy of hadrons. During in total 9 weeks in 2008 and 2009, a 190 GeV/c proton beam impinging on a liquid hydrogen target has been used primarily to study the production of exotic mesons and glueball candidates at central rapidities. As no bias on the rapidity was introduced by the trigger system, the data also yield the unique possibility to study diffractive dissociation of the beam proton while an inert target is assumed. To this end exclusive events with three charged particles including one proton in the final state have been extracted. We will report on the status of the event selection studies and discuss the prospect of using partial wave analysis techniques, which have been successfully applied for diffractive dissociation reactions of pions in COMPASS.

HK 25.4 Di 17:15 HG III

**Pion production in diproton reactions at ANKE** — ●SERGEY DYMOV for the ANKE-Collaboration — Physikalisches Institut II, Universität Erlangen-Nürnberg, 91058 Erlangen, Germany — Laboratory of Nuclear Energy, Joint Institute for Nuclear Research, 141980 Dubna, Russia

The study of processes with the production of proton pairs with small excitation energy (diprotons) provides a new approach to hadron interactions at intermediate energies.

The  $NN \rightarrow NN\pi$  process is one of the principal tools used in the investigation of NN dynamics in this energy range. Because of the large momentum transfers involved, it is sensitive to the short-range part of the NN-interaction. The forward differential cross section for

$pp \rightarrow (pp)_s\pi^0$  obtained in the energy range 0.5–2.4 GeV at ANKE can be compared to the one of the  $pp \rightarrow d\pi^+$  process; the relative strength of spin-singlet to spin-triplet production is extracted.

There are only two spin amplitudes involved  $pN \rightarrow \{pp\}_s\pi$  with the diproton in the  $^1S_0$  state. The measurement of  $d\sigma/d\Omega$ ,  $A_y$  and one spin correlation coefficient is sufficient to extract these amplitudes. A combined study of the  $pp \rightarrow \{pp\}_s\pi^0$  and  $pn \rightarrow \{pp\}_s\pi^-$  processes can be used to isolate the strength parameter  $d$  of the four-nucleon-pion contact interaction in  $\chi$ PT. Preliminary results on the near threshold measurements of  $d\sigma/d\Omega$  and  $A_y$  in these processes at ANKE will be presented.

HK 25.5 Di 17:30 HG III

**The ABC Effect in the Double-Pionic Fusion to  $^4\text{He}$  from exclusive  $dd \rightarrow ^4\text{He}\pi\pi$  measurements\*** — ●ANNETTE PRICKING for the WASA-at-COSY-Collaboration — Physikalisches Institut, Univ. Tübingen and HISKP, Bonn

The ABC effect – an intriguing low-mass enhancement in the  $\pi\pi$  invariant mass spectrum – is known from inclusive measurements of two-pion production in nuclear fusion reactions to the few-body systems  $d$ ,  $^3\text{He}$  and  $^4\text{He}$ . Its explanation has been a puzzle for 50 years.

In an effort to solve this long-standing problem by exclusive and kinematically complete high-statistics experiments, we have measured the fusion reactions to  $d$ ,  $^3\text{He}$  and  $^4\text{He}$  with WASA at COSY. Here we report on the measurements of the double-pionic fusion reactions  $dd \rightarrow ^4\text{He}\pi^0\pi^0$  and  $dd \rightarrow ^4\text{He}\pi^+\pi^-$ , which have been carried out at nine beam energy settings in the range  $T_d = 0.8 - 1.4$  GeV. These measurements cover the full energy region, where the ABC effect has been observed previously in inclusive reactions.

As a result we find a huge low-mass enhancement in the  $\pi\pi$ -invariant mass in agreement with previous measurements. However, we do not observe a pronounced high-mass enhancement, which is seen in the inclusive data and predicted in conventional  $\Delta\Delta$  calculations. This finding is in accordance with the observations in the basic  $pn \rightarrow d\pi^0\pi^0$  reaction. In both reactions we observe a resonant energy dependence of the total cross section, tentatively attributed to a "ABC resonance", which apparently is robust enough to survive even in nuclei.

\* supported by BMBF, COSY-FFE, DFG (Eur. Graduate School)

HK 25.6 Di 17:45 HG III

**Diffraktive Dissoziation von Pionen in drei geladene Pionen bei kleinen Impulsüberträgen bei COMPASS** — ●STEFANIE GRABMÜLLER für die COMPASS-Kollaboration — TU München, Physik Department E18, 85748 Garching

COMPASS ist ein vielseitiges Experiment mit stationärem Target am CERN SPS, das die Struktur und Spektroskopie von Hadronen untersucht. Diffraktive Anregung von Pionen durch Streuung an Kern- oder Wasserstoff-Targets bietet sauberen Zugang zum Spektrum leichter Meson-Resonanzen. Während einer kurzen Strahlzeit im Jahr 2004, mit 190 GeV/c  $\pi^-$  Strahl auf Targets aus dünnen Bleischeiben, wurden ca. 4 Millionen exklusive  $\pi^-\pi^-\pi^+$  Ereignisse aufgezeichnet. Bei den 2 Millionen Ereignissen mit niedrigem Impulsübertrag  $t' \in [0.001, 0.01](\text{GeV}/c)^2$  geht man von kohärenter Streuung am ganzen Bleikern aus, die durch Reggeon- oder Pomeron-Austausch beschrieben werden kann. Bei noch niedrigeren  $t' < 0.001 (\text{GeV}/c)^2$  wird ein Teil der Mesonen auch photo-produziert.

Wir stellen hier den Status der Partialwellen-Analyse dieser Daten vor, und gehen dabei auch auf die Überlagerung von diffraktiver und Photo-Produktion ein.

Diese Arbeit wird vom BMBF, Maier-Leibnitz-Labor München und dem Exzellenzcluster Exc153 unterstützt.

HK 25.7 Di 18:00 HG III

**Comparison of Monte Carlo simulations with first results from the upgraded COSY-TOF detector.** — ●ROMAN DZHYGADLO<sup>1</sup>, ALBRECHT GILLITZER<sup>2</sup>, EDUARD RODERBURG<sup>2</sup>, PETER WINTZ<sup>2</sup>, WERNER GAST<sup>2</sup>, MATTHIAS RÖDER<sup>2</sup>, PAWEŁ KLAJA<sup>3</sup>, and JAMES RITMAN<sup>2</sup> for the COSY-TOF-Collaboration — <sup>1</sup>Universität Bonn — <sup>2</sup>Forschungszentrum Jülich — <sup>3</sup>Universität Erlangen-Nürnberg

The upgrade of the COSY-TOF experiment with the Straw Tube Tracker and the Silicon Quirl Telescope improves both mass resolution

and reconstruction efficiency significantly. Due to its large acceptance and azimuthal symmetry the COSY-TOF detector is an excellent instrument to study complete Dalitz plot distributions of 3-body final states with strangeness. Experimental data from the first physics run with the upgraded detector are being analyzed. For better understanding of the detector response and optimization of the analysis algorithms MC simulations were done. Simulated events were transported through the detector using Geant-3. After digitization the detector response was reproduced. All studies were done within the TOF MC package. Results of the MC simulation will be shown in comparison to the first experimental results.

Supported in part by Forschungszentrum Jülich.

HK 25.8 Di 18:15 HG III

**Investigations of Double Pion Production in Proton-Proton Collisions at  $T_p = 1400$  MeV** — •TAMER TOLBA and JAMES RITMAN for the WASA-at-COSY-Collaboration — Institut für Kernphysik and Jülich Center for Hadron Physics, Forschungszentrum Jülich, Germany

Pion production, especially double pion production, in proton-proton collisions is an important source of information on the nucleon-nucleon ( $NN$ ) interaction and on nucleon resonance properties.

The mechanisms for double pion production in proton-proton collisions are strongly momentum dependent and are expected to be dominated by baryon resonance intermediate states. This channel was studied at energies close to threshold up to  $T_p = 1300$  MeV at the CELSIUS/WASA experiment.

In this work, using the WASA-at-COSY facility, we present new data obtained at higher energy  $T_p = 1400$  MeV ( $Q \approx 330$  MeV). Total and differential cross sections have been determined, and the mechanism of neutral double pion production has been investigated by comparing the results to expectations calculated by the Valencia theoretical group.

Supported in part by BMBF, FZ-Jülich and the Wallenberg Foundation.

HK 25.9 Di 18:30 HG III

**Energy dependence of the cross section for  $pp \rightarrow \{pp\}_s \gamma$  at intermediate energies** — •DMITRY TSIRKOV, TATYANA AZARYAN, SERGEY DYMOV, VLADIMIR KOMAROV, ANATOLY KULIKOV, VLADIMIR KURBATOV, and GEORGE MACHARASHVILI for the ANKE-Collaboration — Laboratory of Nuclear Problems, Joint Institute for Nuclear Research, 141980 Dubna, Russia

The fundamental reaction  $pp \rightarrow \{pp\}_s \gamma$ , where  $\{pp\}_s$  is a proton pair with excitation energy of  $E_{pp} < 3$  MeV, has been observed with the ANKE spectrometer at COSY-Jülich. The reaction is a time reverse to photodisintegration of a free  $^1S_0$  diproton for photon energies  $E_\gamma \approx T_p/2$ . Previously only photodisintegration of a diproton bound within a nucleus has been observed. The integral cross section of the reaction was measured in the range of c. m. angles  $0^\circ < \theta_{pp} < 20^\circ$  for proton beam energies of  $T_p = 0.353, 0.500, 0.550, 0.625, 0.700$  GeV, as well as upper limit for 0.800 GeV. The energy dependence obtained shows clear bump around  $T_p = 0.625$  GeV, which may reflect the influence of the  $\Delta(1232)$  excitation, even though this mechanism is suppressed compared to that in a similar  $np \rightarrow \gamma d$  reaction. The results of the research might help to understand the underlying dynamics of the short range  $NN$  and  $N\Delta$  interaction, since quantum numbers for the  $pp \rightarrow \{pp\}_s \gamma$  reaction differ from those of the extensively studied deuteron photodisintegration.

Supported by the COSY-FFE program.

HK 25.10 Di 18:45 HG III

**Diffraktive Dissoziation von Pionen in Endzustände mit drei geladenen Pionen bei hohen Impulsüberträgen** — •FLORIAN HAAS für die COMPASS-Kollaboration — TU München, Physik Department E18, 85748 Garching

Die diffraktive Anregung von Pionen durch Streuung an Kern- oder Wasserstoff-Targets, wie sie am COMPASS Experiment durchgeführt wird, erlaubt einen sehr guten Zugang zum Spektrum leichter Meson-Resonanzen, insbesondere zu nicht- $q\bar{q}$  Zuständen. Diese können durch exotische Quantenzahlen, wie  $J^{PC} = 1^{-+}$ , identifiziert werden. Die Analyse von Daten einer Teststrahlzeit in 2004 mit einem Blei-Target, welches von einem  $\pi^-$  Strahl getroffen wurde, ergab die Existenz solch eines exotischen Signals mit eben diesen Quantenzahlen bei einer Masse von  $1.66$  GeV/ $c^2$ . Im Jahre 2008 wurde eine weltweit einmalige Anzahl von exklusiven  $\pi^- \pi^- \pi^+$  Ereignissen mit einem  $190$  GeV/ $c$   $\pi^-$  Strahl, der auf ein Flüssigwasserstoff-Target trifft, aufgezeichnet. Im Fokus der vorliegenden Analyse sind Ereignisse mit hohen Impulsüberträgen  $t' \in [0.1, 1.0]$  (GeV/ $c$ ) $^2$  und Resonanz-Massen kleiner  $2.5$  GeV/ $c^2$ . Dies ist der gleiche kinematische Bereich der auch schon mit den Daten von 2004 analysiert worden ist.

Wir stellen den Status der Partialwellen-Analyse der Daten aus dem Jahre 2008 vor. Von besonderem Interesse ist der Vergleich der verschiedenen Targets der beiden Strahlzeiten.

Diese Arbeit wird vom BMBF, Maier-Leibnitz-Labor München und dem DFG Exzellenzcluster Exc153 unterstützt.