HK 69: Instrumentation

Zeit: Donnerstag 14:00–16:15 Raum: WIL-A221

Gruppenbericht HK 69.1 Do 14:00 WIL-A221

Der PANDA-Luminositätsdetektor — Florian Feldbauer[1,2], Miriam Fritsch[1,2], •Prometeusz Jasinski[1,2], Anastasia Karavdina[2], Heinrich Leithoff[1,2], Mathias Michel[1,2], Stefan Pflüger[1,2] und Tobias Weber[1,2] — [1]Helmholtzinstitut-Mainz — [2]Universität-Mainz

Mit PANDA wird am Antiprotonenring des Beschleunigerkomplexes FAIR in Darmstadt ein Experiment zur Verfügung stehen, das für Fragen der Hadronphysik optimiert ist. Mit dieser Anlage wird es möglich sein, neue Zustände zu entdecken und die Linienform dieser wie auch bereits bekannter Zustände sehr präzise zu vermessen. Die dafür verwendeten Energie-Scan-Messung benötigt die exakte Kenntnis der Luminosität zur Normierung.

Die Luminosität wird bei PANDA anhand der Winkelverteilung der elastischen Antiproton-Proton-Streuung gemessen. Dazu wird der Luminositätsdetektor 11 m hinter dem Wechselwirkungspunkt nahe der Strahlachse (3.5-8mrad) im Vakuum platziert, um die Unsicherheit in der Bestimmung der Luminosität durch Kleinwinkelstreuung und Modellannahmen zu minimieren. Angestrebt ist eine Messgenauigkeit von 3 %. Die Teilchenspuren werden mit 4 Detektorebenen rekonstruiert. Diese sind mit HV-MAPS bestückt, die auf wärmeleitenden CVD-Diamantscheiben aufgebracht werden.

Das Konzept des Luminositätsdetektors wird vorgestellt und dabei technische Aspekte wie Vakuumsystem, Kühlung und Elektronik diskutiert.

HK 69.2 Do 14:30 WIL-A221

Bestimmung der Luminosität mit dem PANDA Luminositätsdetektor — •Stefan Pflüger[1,2], Florian Feldbauer[1,2], Miriam Fritsch[1,2], Prometeusz Jasinski[1,2], Anastasia Karavdina[1], Heinrich Leithoff[1,2], Mathias Michel[1,2] und Tobias Weber[1,2] für die PANDA-Kollaboration — [1]Universität Mainz — [2]HI Mainz

Das PANDA Experiment, das am neuen Beschleunigerkomplex FAIR der GSI in Darmstadt entsteht, ist für Hadronspektroskopie optimiert. Im Vordergrund steht die Suche nach neuen Zuständen und die präzise Vermessung bereits entdeckter Zustände, z.B. dem X(3872). Die erforderliche Präzision für diese Messungen kann nur mit Hilfe der Energie-Scan-Methode erreicht werden. Voraussetzung für die Normierung der Messpunkte untereinander, ist die genaue Messung der Luminosität.

Bei PANDA wird die Luminosität mittels elastischer Antiproton-Proton-Streuung im Winkelbereich von 3-8 mrad gemessen. Dies hat den Vorteil, dass der Coulomb-Anteil der elastischen Streuung dominiert, der exakt berechnet werden kann. Der Luminositätsdetektor liegt ausserhalb des Magnetfeldes hinter dem PANDA-Spektrometer und besteht aus 4 Ebenen mit Silizium-Pixel-Detektoren (HV-MAPS, High Voltage Monolithic Active Pixel Sensor). Im Anschluss an die Spurrekonstruktion der elastisch gestreuten Antiprotonen wird die integrierte Luminosität extrahiert. Systematische Unsicherheiten bei der geometrischen Akzeptanz, Detektorauflösung und Lage und Form des Antiprotonenstrahls haben Einfluss auf die Genauigkeit der Luminositätsmessung und werden in diesem Beitrag vorgestellt.

HK 69.3 Do 14:45 WIL-A221

Development of a Compton Camera for online monitoring and dosimetry of laser-accelerated proton beams* — •Peter G. Thirolf[1], Christian Lang[1], Saad Aldawood[1], Dietrich Habs[1,2], Ludwig Maier[3], and Katia Parodi[1] — [1]LMU München — [2]MPI f. Quantenoptik, Garching — [3]TU München

A Compton camera is presently under construction in Garching, designed for monitoring and dosimetry of laser-accelerated protons for bio-medical applications via position-resolved prompt γ-ray detection. When ion beams suitable for hadron therapy (protons, carbon ions) interact with tissue (or tissue-equivalent plastic or water phantoms), nuclear reactions induce prompt γ rays that can be utilized, e.g., to verify the ion beam range (i.e. monitor the Bragg peak position) by exploiting the Compton scattering kinematics of these photons. Our Compton camera (formed by a combination of scatter and absorber detector) consists of a stack of six double-sided Si-strip detectors (50x50 mm^2, 0.5 mm thick, 128 strips/side, pitch 390 μm) acting as scatterers, while the absorber is formed by a $LaBr_3$ scintillator crystal (50x50x30 mm^3), read out by a (8x8) pixelated multi-anode PMT. Simulation results for design specifications and expected values of resolution and efficiency will be presented, as well as the status of the prototype presently under construction.

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HK 69.4 Do 15:00 WIL-A221

Scintillating screens for intense heavy ion beams — •Eiko Gütlich[1], Peter Forck[2], Wolfgang Ensinger[3], and Oliver Kester[1,2] — [1]Goethe-Universität Frankfurt, Institut für Angewandte Physik — [2]GSI Helmholtzzentrum für Schwerionenforschung — [3]Technische Universität Darmstadt, Materialwissenschaften

Beam diagnostics is a fundamental part of every particle accelerator. In contrast to other methods, scintillating screens are a very cost efficient and simple method to determine the transversal beam properties. They are used for the qualitative beam alignment as well as for optimization of the beam intensity distribution in nearly all accelerators. To perform quantitative measurements with scintillating screens the imaging properties, aging and dynamical behaviour have to be known. Thus, extensive investigations have been carried at the GSI linear accelerator UNILAC. Due to the energy deposition of heavy ions with kinetic energy of 11.4 MeV/u, the resulting dose rates for the materials are up to 10^{12} Gy/h. The high dose rates and heat loads limit the potential screen materials to radiation hard materials like ceramic Al_2O_3 or ZrO_2. The measurements show that the imaging quality can depend on the materials itself, its temperature, the accumulated fluence $[ions/cm^2]$, the flux $[ions/(cm^2 * s)]$, the ion energy as well as the observed emission wavelength. For Al_2O_3 a model has been developed to explain the observed saturation effects. To validate the model, experiments with a known ion beam distribution and flux have been carried out. For Carbon and Titanium ions with kinetic energy of 11.4 MeV/u the flux and the pulse length have been varied.

HK 69.5 Do 15:15 WIL-A221

A multiple-reflection time-of-flight isobar separator for TITAN at TRIUMF — •Christian Jesch[1], Timo Dickel[1,2], Wolfgang Plass[1,2], Jens Ebert[1], Hans Geissel[1,2], Johannes Lang[1], Moritz Pascal Reiter[1], Christoph Scheidenberger[1,2], and Mikhail I. Yavor[3] — [1]Justus-Liebig-Universität Gießen — [2]GSI, Darmstadt — [3]Inst. for Analytical Instrum., Russian Academy of Sci., St. Petersburg

The production of radioactive ion beams via the ISOL method has the advantage of a high yield of the desired radioisotope. The often even higher production and ionization yields of contaminants requires efficient separation methods. The commonly used magnetic separators with mass resolving power of a few 10^3 allow the separation of contaminants with a mass difference ≥ 1 amu but no preparation of an isobarically clean beam.

TRIUMF's Ion Trap for Atomic and Nuclear science, TITAN, is a facility for mass measurements, laser spectroscopy and nuclear branching ratio measurements in Vancouver, Canada.

In order to extend TITAN's capabilities, a specialized multiple-reflection time-of-flight mass spectrometer has been developed in order to provide an efficient, fast ($\approx$ ms), high mass resolving power ($\approx 10^5$) and high capacity ($> 10^6$/s) isobar separation of the radioactive nuclei. The separator concept, its design and preliminary results will be presented.

HK 69.6 Do 15:30 WIL-A221

Status of the Intrap project at MLLTRAP — •Peter Müller, Jasmin Moazzami-Fallah, Jurek Szerypo, Peter G. Thirolf, and Christine Weber — Fakultät für Physik, LMU München, 85748 Garching

The precision of decay-spectroscopy experiments is limited due to scattering effects in the source material. However, well-localized ions in a Penning trap can be considered as an ideal, carrier-free source. In order to investigate alpha- and conversion-electron decays, a novel type of "Detector-Trap" is presently under construction at the Garching double Penning-trap facility MLLTRAP for the future MATS facility at FAIR. Here, the trap's ring electrode is replaced by a cubic detector array, also providing the trapping potential. It consists of four position-sensitive silicon strip detectors, which allow for a measurement of energy spectra and enable a determination of the decay axis of stored alpha-emitters. Moreover, low-energetic electrons from conversion decays are efficiently guided along the magnetic field lines and detected in the fringe field region of the trap's superconducting magnet. For this purpose, alpha- and electron detectors are presently developed, and extensively characterized under the future ambient conditions given in the MATS experimental setups. This presentation reports on the physics goals of future experiments and gives an overview on the present status of the developments.

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HK 69.7 Do 15:45 WIL-A221

Feasibility studies for the EXL project at the ESR storage ring — •J.C. Zamora for the EXL E105-Collaboration — Institut für Kernphysik, TU Darmstadt

The objective of the EXL project is the investigation of nuclear structure of EXotic nuclei in Light-ion induced reactions, by using the storage ring NESR (at FAIR). In this project a universal detector system will provide high resolution and large solid angle coverage for kinematically complete measurements.
In a recent experiment at the present ESR storage ring, the collaboration has performed feasibility studies and first experiments by using a dedicated detector setup including UHV capable DSSD's and PIN diodes for the detection of target like recoil ions, and beam like reaction products, respectively. With this setup the interaction of ^{56,58}Ni beams with internal hydrogen and helium gas-jet targets was investigated. Some preliminary results from this experiment will be presented, together with GEANT4 simulations employed to understand the different reaction channels observed. This work is supported by BMBF (06DA9040I and 05P12RDFN8) and HIC for FAIR.

HK 69.8 Do 16:00 WIL-A221

design of internal superconducting polarizing solenoid for frozen spin target — •James Linturi for the A2-Collaboration — Institute fuer kernphysik,mainz, germany

scattering experiments with polarized targets and beams are necessary to check the present models and to achieve a better knowledge of the nucleon structure. The development of the frozen spin target technique has opened the possibility to use a polarized target with high density of polarized nucleons in combination with a particle detector with nearly 4π solid angle. Thus, high luminosity experiments, even with low intensity beams, can be performed. The frozen spin target at MAMI uses a thin, superconducting holding coil inside the refrigerator to keep the polarization with a relaxation time in the order of 1000 hours. After a measurement period of approximately one week the detector or the target has to be changed and the target material has to be re-polarized in a strong superconducting magnet. This leads to a loss in beamtime and overall efficiency.

To allow a continuous operation of the target, the theory and design of a 10 layer notched internal superconducting solenoid of length 13.6cm and radius 2.4cm is described. Calculations of the magnetic field inside the solenoid are summarized. The simulated results show that it is possible to attain a magnetic field of 2.5T with homogeneity of 10-4 at the target region.