HK 53: Instrumentation XII

Zeit: Donnerstag 14:00–16:00 Raum: HS 12

Gruppenbericht HK 53.1 Do 14:00 HS 12

Status of the CBM Time-of-Flight system — •Ingo Deppner and Norbert Herrmann — Physikalisches Institut, Uni Heidelberg

To provide particle identification (PID) of charged hadrons at the future high-rate Compressed Baryonic Matter (CBM) experiment the collaboration has developed a large-area Time-of-Flight (ToF) wall equipped with multi-gap resistive plate chambers (MRPC). The MRPC detectors were designed and tested in beam to maintain an efficiency of at least 95varying particle fluxes of up to a few kHz/cm^2. Prior to its destined operation at the Facility for Antiproton and Ion Research (FAIR) - starting in 2025 - this high-rate timing MRPC technology will be used for physics research at two scientific pillars of the FAIR Phase-0 program: the end-cap TOF upgrade of the STAR experiment at RHIC and the mTOF wall of the mCBM experiment at SIS18. At STAR, the fixed- target program of the Beam Energy Scan II (BES-II) will rely on 108 CBM MRPC detectors for forward PID at interaction rates of up to 2 kHz with 2.9 to 30.3 AGeV Au beams. At mCBM, high-performance benchmark runs of Λ production at top SIS18 energies (1.5/1.9 AGeV for Au/Ni beams) and CBM design interaction rates of 10 MHz will become feasible with a PID backbone consisting of 25 CBM MRPC detectors. Apart from the physics perspective, these pre-FAIR involvements will help gathering experience in operating the final CBM TOF wall with about 1500 MRPC detectors and 110,000 readout channels. The project is partially funded by BMBF 05P15VHFC1.

HK 53.2 Do 14:30 HS 12

Analysis of CBM - TOF module response with cosmic rays — •Dennis Sauter for the CBM-Collaboration — Physikalisches Institut, Universität Heidelberg, Deutschland

The future Compressed Baryonic Matter (CBM) experiment is planned to utilize MRPC detectors for its 120 m^2 large ToF wall. To reconstruct the majority of the produced particles at an interaction rate of up to 10 MHz, it is of utmost importance that detection efficiency reaches upper values close to 100of 50-60 ps. The MRPC prototypes 3a & 3b are planned to be used in the intermediate and low rate region of the wall with expected fluxes of a few kHz/cm^2. Utilizing cosmic muon radiation, these prototypes were extensively tested before exposing them to their designed rate, which will happen in the mCBM experiment in 2019 at GSI. With a test setup of 6 stacked MRPCs and through analysis with the CBM Tracker class it was possible to verify the required level of performance on both types. In addition, signals of particles that seemed to come from below the setup were found. This property of the tracker allowed for distinguishing between muons and their decay products, electrons.

HK 53.3 Do 14:45 HS 12

Commissioning and calibration of a precision high voltage divider for the electron cooler at CRYRING@ESR — •Daniel Winzen[1], Ilian Denesjuk[1], Volker Hannen[1], Wilfried Nörtershäuser[2], Hans-Werner Ortjohann[1], Oliver Rest[1], and Christian Weinheimer[1] — [1]WWU Münster — [2]TU Darmstadt

In high precision experiments at ion storage rings the velocity of the ions is a critical quantity. For measurements at CRYRING@ESR (GSI/FAIR) the electron cooler determines the ion velocity and momentum spread of the stored ions by superimposing the ion beam with a mono-energetic electron beam. Therefore, a precise knowledge of the acceleration voltage used to produce the electron beam is essential for the accuracy of the experiments. At the University of Münster we constructed a precision divider for voltages up to 35 kV with a similar design to the well-established and tested KATRIN dividers (K35 and K65) that were developed in Münster in cooperation with the PTB.

We will present calibration and stability measurements that characterize the performance of the high voltage divider. With a novel absolute calibration method the voltage dependency of the dividers scale factors could be measured to the ppm-level. As a consequence, it is possible to conduct ppm-precise voltage measurements over the whole 35 kV range of the divider. This work was supported by BMBF under contract number 05P15PMFAA, GSI F&E project MSWEIN1416 and HGS-HIRe for FAIR.

HK 53.4 Do 15:00 HS 12

Comissioning of the $\overline{\text{P}}$ANDA Cluster-Jet Target at COSY — •Benjamin Hetz, Daniel Bonaventura, Silke Grieser, Daniel Klostermann, and Alfons Khoukaz for the PANDA-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

The internal cluster-jet target build up and already routinely in operation at the University of Münster will be the phase one target for the upcoming $\overline{\text{P}}$ANDA experiment at the antiproton storage ring HESR at FAIR. In June 2018 this target was transfered from Münster to the COSY accelerator at FZ Jülich and setup up in next to $\overline{\text{P}}$ANDA geometry. In August 2018 a first commissioning beam time has been performed with the desired $\overline{\text{P}}$ANDA at HESR target thickness of more than 10^{15} atoms/cm^2 and first data on a rich experimental program was gained. This includes, e.g., beam-target interaction, energy loss studies, Schottky measurements, beam heating investigations, emittance growth by the target, and the physical data quality was investigated using the WASA forward detection system by studying the π^0 production reaction in pp-collisions. Furthermore, the $\overline{\text{P}}$ANDA cluster-jet target has been used very successfully in additional beam times in combination with the HESR/COSY stochastic cooling and 2 MeV electron cooler, yielding important insights into the later HESR cooling performance with highest target thickness and high accelerator beam current. Results of this beam times and the upcoming experimental program of the $\overline{\text{P}}$ANDA cluster-jet target at COSY will be presented within this talk.

HK 53.5 Do 15:15 HS 12

Gas Flow Simulations for the Design of Jet Nozzles for Cluster-Jet Targets — •Philipp Brand, Daniel Bonaventura, Silke Grieser, Alfons Khoukaz, and Lukas Lessmann for the MAGIX-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

The future MAGIX experiment (MESA Gas Internal target eXperiment) aims for high precision measurements of the electromagnetic form factors, the astrophysical S-factor and for the search of the dark photon. It will be located in the energy recovery arc of the electron accelerator MESA (Mainz Energy-recovering Superconducting Accelerator) which will deliver an 105 MeV electron beam with currents of up to 10 mA. To achieve luminosities of $10^{35}\,\text{cm}^{-2}\text{s}^{-1}$, target thicknesses up to 10^{19} atoms/cm^2 are required which will be fulfilled directly behind the nozzle of a windowless cluster-jet target designed and built up at the University of Münster. Due to the high gas load this target works close to the transition from a gas jet to a cluster-jet target which makes the nozzle design crucial. For a complete understanding of the expansion process within the nozzle, computational fluid dynamics (CFD) is used to simulate the gas flow through different nozzle designs. The results of these simulations are presented and compared to measurements performed at MAMI (MAinz MIcrotron) with the MAGIX target. Finally, the consequences of the different nozzle designs for the cluster production are discussed.

HK 53.6 Do 15:30 HS 12

Collinear Laser Spectroscopy for High Voltage Metrology at 1 ppm relative precision — •Patrick Mueller[1], Joerg Kraemer[1], Kristian Koenig[1], Christopher Geppert[2], Phillip Imgram[1], Bernhard Maass[1], Johann Meisner[3], Ernst W. Otten[4], Stephan Passon[3], Tim Ratajczyk[1], Johannes Ullmann[1,5], and Wilfried Noertershaeuser[1] — [1]Inst. f. Kernphysik, Technische Universitaet Darmstadt — [2]Inst. f. Kernchemie, Johannes Gutenberg Universitaet Mainz — [3]Physikalisch-Technische Bundesanstalt, Braunschweig — [4]Inst. f. Physik, Johannes Gutenberg Universitaet Mainz — [5]Inst. f. Kernphysik, WWU Muenster

Electrostatic acceleration or deceleration is an integral part of many nuclear and atomic physics experiments. If the goal is to exactly define or measure a particle's kinetic energy, accurate high voltage measurements become inevitable. The best high-voltage dividers provide accuracy at the 1-ppm level by scaling down high voltages via resistor chains, however regular elaborate calibration and cross checking is needed. This process can be obviated by directly attributing voltage to frequency, exploiting the Doppler effect on accelerated ions. We report on improved measurements at the ALIVE experiment at TU Darmstadt for high voltage determination using a pump-and-probe approach on accelerated Ca^+ ions using two lasers to address the Ca^+ ions before and after the acceleration. In the latest configuration a relative precision of 1 ppm was achieved. The absolute nature of the measurement allows the definition of a new high voltage standard and constitutes a reliable calibration apparatus for high voltage dividers.

HK 53.7 Do 15:45 HS 12

Investigations of the KATRIN interspectrometer Penning trap — •Mariia Fedkevych — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Deutschland

The KArlsruhe TRItium Neutrino experiment (KATRIN) is aiming to probe the average electron (anti)neutrino mass with a sensitivity of 0.2 eV/c^2 (90 % C.L.). It uses a pair of electrostatic spectrometers of MAC-E filter type to analyze energies of electrons from tritium-β-decay. In the region between the spectrometers, a Penning trap is created by their retarding potentials combined with the magnetic field produced by a superconducting magnet. Electrons accumulating in this trap can lead to discharges which create additional background and may damage parts of the spectrometer and detector section of KATRIN. To counteract this problem, electron catchers were implemented in the beamline part between the two spectrometers to remove trapped electrons. The system was comissioned and showed its effectiveness for suppression of the Penning trap effects. Details of the measurements and experimental results will be presented. This work is supported under BMBF contract 05A17PM3.