HK 22: Instrumentierung IV

Zeit: Dienstag 14:00–16:00 Raum: HG IX

Gruppenbericht HK 22.1 Di 14:00 HG IX

First results from the Advanced GAmma Tracking Array Demonstrator — •Andreas Wiens[1], Benedikt Birkenbach[1], Bart Bruyneel[1], Juergen Eberth[1], Herbert Hess[1], Daniel Lersch[1], George Pascovici[1], Peter Reiter[1], and Heinz-Georg Thomas[2] for the AGATA-Collaboration — [1]IKP, Universität zu Köln — [2]CTT, Montabaur

The Advanced Gamma Ray Tracking Array, a 4π γ-ray spectrometer, is based on the principle of gamma-ray tracking which provides an optimal energy resolution, a very high efficiency and a position sensitivity of a few millimeters for energy depositions after γ-ray interactions. The AGATA demonstrator started operation at LNL Legnaro after commissioning experiments employing the complete detection sequence. Four AGATA triple cluster detectors comprising each three highly segmented HPGe detectors are operated together with electronics digitizing the acquired pulses. Online pulse shape analysis is successfully used to determine the positions of the γ-ray interaction points. The energies and coordinates of coincident interactions are processed by the tracking algorithm. The tracking procedure is validated by demonstrating an improved energy resolution after Doppler correction. Different type of nuclear reactions were exploited at Legnaro to study coincidences between charged particle detectors or the PRISMA spectrometer and the AGATA demonstrator array. Latest results of the first in-beam experiments will be presented. Supported by the German BMBF(06K-167, 06KY205I)

HK 22.2 Di 14:30 HG IX

Status report on cryogenic stopping cell for the Low-Energy Branch of the Super-FRS at FAIR — •Sivaji Purushothaman[1], Manisha Ranjan[2], Peter Dendooven[2], Wolfgang Plass[1,3], and Christoph Scheidenberger[1,3] — [1]GSI, Darmstadt, Germany — [2]KVI, University of Groningen, Netherlands — [3]Justus Liebig University,Giessen, Germany

Low energy branch of the Super-FRS at FAIR in Darmstadt, Germany, will allow studies of radioactive isotopes using laser techniques and ion traps. For this purpose, we are developing an ion catcher that will stop high-energy ions from the Super Fragment Recoil Separator (Super-FRS) in helium gas and extract them as a low-energy beam using DC and RF electric fields. The high purity of the helium gas will be ensured by operation at low temperature. We are constructing a gas cell with a stopping volume of length 1 m and diameter 0.30 m. To ensure fast and efficient extraction of the ions stopped throughout the volume of the cell we have opted for a DC field throughout the length of the cell and an RF carpet with DC field superimposed at the exit side to guide the ions towards the exit-hole without hitting the wall. As high-density operation (up to 0.2 mg/cm^3) is aimed for, we plan to push the limits of DC field and RF force. The way these goals are translated into the design will be shown. The status of the development of a cryogenic gas catcher for the Super-FRS at FAIR will be presented. Details of the mechanical and electronic design will be shown and the cooling and temperature control systems will be discussed.

HK 22.3 Di 14:45 HG IX

Development of a beam profile monitor for degraded beams at HISPEC/DESPEC at FAIR — •Michael Pfeiffer[1], Gheorghe Pascovici[1], Nigel Warr[1], Farheen Naqvi[2], and Jan Jolie[1] — [1]IKP, Universität zu Köln — [2]GSI, Darmstadt

In the context of the HISPEC/DESPEC part of NUSTAR at FAIR-GSI we are investigating the development of new tracking detectors to reconstruct the kinematics of the ions after they are decelerated to energies of about 5MeV/u. The main issue encountered with slowing down relativistic beams is the energy straggling and the spread in space and direction of these beams. Thereby, new generations of beam-characterization detectors are requested to allow not only the precise determination of the position of an incoming ion and its energy loss but also the arrival time (for time of flight purposes-TOF) and if possible to reconstruct the ion track (Beam Tracking Detector), as well.

Our solution uses the secondary electrons generated by ions passing through a thin sheet of material ($80-120\mu$g/cm^2). Two basic units of large sensitive area ($\sim$ 80x100mm^2) are placed downstream of the beam axis and electrostatic mirrors project the secondary electrons on the position sensitive detectors.

The transparency of each component is $\sim$ 90%, making the overall transparency of one unit $\sim$ 70%. We aim to get an angular resolution of about $1.5-2.5\cdot 10^{-2}$steradian with a sub-ns resolution for the TOF. Even though the S/N ratio per current pulse is very promising, we are facing a very high pulse shot noise at the MCP outputs. The source of these additional electrons is under investigation.

HK 22.4 Di 15:00 HG IX

A novel liquid nitrogen fill level meter for the AGATA triple cluster detector — •Daniel Lersch[1], Benedikt Birkenbach[1], Bart Bruyneel[1], Herbert Hess[1], Jürgen Eberth[1], Gheorghe Pascovici[1], Peter Reiter[1], Heinz Georg Thomas[2], and Andreas Wiens[1] for the AGATA-Collaboration — [1]Institut für Kernphysik, Universität zu Köln — [2]CTT, Montabaur

The final Advanced Gamma Tracking Array (AGATA) will comprise 60 triple cluster detectors. Each cluster consists of three 36-fold segmented HPGe-crystals which are operated at temperatures below 80 K. Thus cooling the detectors with liquid nitrogen and a direct monitoring of the liquid nitrogen level inside the detector dewar is a desirable, crucial feature for operating the spectrometer. A novel liquid nitrogen fill level meter is based on a capacity measurement which is enabled by including a conducting cylinder into the dewar of the cryostat. The fill level dependent capacity difference of less then 10 % between full and empty is converted by a C/V-transducer. To accomodate for the non linear position dependence of the fill level inside the cylinder capacity measurements were performed with AGATA detectors at various inclinations and rotation angles of the detector axis. A supplementary result of the studies are detailed investigations of the liquid nitrogen consumption and the heat loss of the detector during different modes of operation.

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HK 22.5 Di 15:15 HG IX

Space charge distribution in AGATA detectors — •Benedikt Birkenbach, Bart Bruyneel, Jürgen Eberth, Herbert Hess, Daniel Lersch, Gheorghe Pascovici, Peter Reiter, and Andreas Wiens for the AGATA-Collaboration — IKP, Universität zu Köln

The Advanced Gamma Tracking Array (AGATA) utilizes pulse shape analysis to localize the γ-ray energy deposition within the 36 segmented high purity Germanium detector. Pulse shape analysis is based on measured or calculated datasets of position dependent γ-ray interactions. The space charge distribution within the n-type HPGe crystals is an essential parameter needed for the calculations. A novel technique, based on a capacitance voltage analysis, was developed to determine the impurity concentration of the large volume detector in three dimensions. The capacitances of the bulk detector and each individual segment were measured as a function of the bias voltage, utilizing the newly developed pulser of the core preamplifier. The results of the method are in good agreement with direct capacitance measurements and results of elaborated computer simulations. The extracted impurity concentrations are about 10^{16} atoms per cubic meter. They agree well with the results of analytical approaches and a few data points provided by independent measurements of the crystal manufacturer.

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HK 22.6 Di 15:30 HG IX

Characterization of LN2 cooled APDs for Single Photon Counting Applications — Denis Anielski[1], Wladimir Buglak[1], •Raphael Jöhren[1], Volker Hannen[1], Rubén Lopéz Coto[1], Wilfried Nörtershäuser[2,3], Rodolfo Sánchez[3], and Christian Weinheimer[1] — [1]Institut für Kernphysik, Universität Münster — [2]Institut für Kernchemie, Universität Mainz — [3]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

Avalanche Photo Diodes (APDs) operated near LN2 temperature are one of the technologies under investigation for the detection of low levels of fluorescence light produced in the laser spectroscopy experiment SPECTRAP at GSI. Measurements of hyperfine transitions in highly charged ions require single photon detection capabilities from the UV to the near infrared. With high quantum efficiencies in the visible and NIR region (up to 1064 nm), APDs are a possible candidate for measurements of the hyperfine transitions e.g. in 207Pb81+. Problems arise due to large dark count rates of the APDs when operated at room temperature or with modest cooling only. To characterize dark current, gain and SNR of the detectors as a function of temperature and bias voltage, a LN2 cooled cryogenic test bed has been set up at the nuclear physics institute in Münster. To minimize the noise contribution from external sources a low noise preamplifier tailored to operation at low temperatures inside the vacuum has been developed. We will present the latest results regarding the performance of the preamp design and the temperature behavior and photon detection efficiency of the tested APDs. This work is supported by an R&D contract with GSI.

HK 22.7 Di 15:45 HG IX

Pile-Up Korrektur für hochauflösende Germanium Detektoren mittels eines Kalman Filters* — •Deniz Savran[1,2,3], A. Likar[2,4], R. Novak[2] und M. Vencelj[2] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]Jozef Stefan Institute, Ljubljana, Slovenia — [3]Innovation Centre for Advanced Sensors and Sensor Systems, INCAS[3], Assen, The Netherlands — [4]Faculty of Mathematics and Physics, University of Ljubljana, Slovenia

In vielen Experimenten, bei denen hochreine Germanium (HPGe) Detektoren zur γ-Spektroskopie eingesetzt werden, stellen die Zählraten in diesen den limitierenden Faktor dar. Mit konventioneller analoger Elektronik sind diese üblicherweise auf einen Wert unterhalb von 10-15 kHz beschränkt. Das Aufkommen von schnellen FlashADCs mit gleichzeitig hoher Auflösung ermöglicht völlig neue Analysemethoden basierend auf den digitalisierten Detektorsignalen. In diesem Beitrag stellen wir eine neue Methode vor, die auf der Anwendung eines Kalman Filters [1] auf den digitalisierten Datenstrom eines HPGe Detektors beruht und es ermöglicht die Begrenzungen in der handhabbaren Zählrate um weit über eine Grössenordnung zu erhöhen. Ergebnisse für die erzielte Auflösung und Durchsatzraten für experimentelle Daten bis hinauf zu 1 MHz werden präsentiert.

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[1] R.E. Kalman, Trans. ASME, J. Basic Eng. 82 (1960) 35-45