HK 46: Instrumentation

Zeit: Dienstag 16:45–19:15 Raum: WIL-A221

HK 46.1 Di 16:45 WIL-A221

CBM Time-of-Flight wall layout - design considerations — •Ingo Deppner and Norbert Herrmann for the CBM-Collaboration — Physikalisches Institut, Universität Heidelberg

The Compressed Baryonic Matter spectrometer (CBM) is expected to be operational in the year 2018 at the Facility for Anti-proton and Ion Research (FAIR) in Darmstadt, Germany. The key element providing hadron identification at incident energies between 2 and 10 AGeV is a Time-of-Flight (ToF) wall covering the polar angular range from 2.5°-25° and full azimuth [1]. The necessary particle identification capabilities require a 80 ps system time resolution at high efficiency and, due to 10 MHz interaction rate, a rate capability of up to 30 kHz/cm^2. We will discuss the existing conceptual design which foresees a 120 m^2 ToF-wall composed of Multi-gap Resistive Plate Chambers (MRPC) constructed in a multi-strip configuration. The wall is designed in a modular way such that it can be located at a distance of 6 m downstream of the target for SIS 100 and with additional components at 10 m for SIS 300. The performance will be discussed on the basis of two fully differential MRPC full size prototypes developed at our institute.

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[1] I. Deppner et al., The CBM time-of-flight wall, Nucl. Instr. and Meth. A, 661, Sup. 1 (2012), p. 121 doi.org/10.1016/j.nima.2010.09.165

HK 46.2 Di 17:00 WIL-A221

Ceramic Resistive Plate Chambers for High Rate Environments — •Alejandro Laso Garcia, Marcus Kaspar, Burkhard Kämpfer, Roland Kotte, Lothar Naumann, Daniel Stach, Christian Wendisch, and Jörn Wüstenfeld for the CBM-Collaboration — Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Sachsen

The future Compressed Baryonic Matter Experiment to be built at FAIR is foreseen to use Resistive Plate Chambers as Time of Flight detectors. However, for the most central part of the ToF Wall high particle fluxes are expected, the simulations predict fluxes in the order of 2x10^4 particles/cm^2 s and even higher the closer the wall approaches the beampipe. This high fluxes show the need to develop new materials.

At Helmholtz-Zentrum Dresden Rossendorf, new semiconductor ceramic composites have been developed, several prototypes of RPCs with ceramic electrodes up to 20x20 cm^2 have been developed and tested.

In this talk, the performance of this detectors in electron (ELBE) and proton (COSY) beams will be presented, as well as, the performance of this detectors under irradiation in Ni+Pb collisions at 1.9 AGeV (SIS18, GSI). This performance can be quantified as an efficiency close to 100% and a time resolution better than 100 ps.

HK 46.3 Di 17:15 WIL-A221

Load test of RPC prototypes — •Christian Simon and Norbert Herrmann for the CBM-Collaboration — Physikalisches Institut and Department of Physics and Astronomy, Ruprecht-Karls-Universität Heidelberg, D-69120 Heidelberg, Germany

The Time-of-Flight (ToF) wall of the Compressed Baryonic Matter experiment (CBM), conceptualized on the basis of high-resolution timing Multi-gap Resistive Plate Chambers (MRPC), is intended to account for concise hadron identification at an unprecedented event rate of 10 MHz. To explore the performance and limitations of the current design, high-rate tests with GSI/SIS-18 heavy ion beams irradiating the full surface of a $30 \times 30\,\mathrm{cm}^2$, fully differential multi-strip MRPC demonstrator have been performed in the fall of 2012.
A calibration scheme adjusted to the layout of the prototype has been developed and will be described. Preliminary results concerning efficiency and timing resolution will be presented as function of the incident particle flux.

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HK 46.4 Di 17:30 WIL-A221

Significantly increased lifetime of recent microchannel-plate photomultipliers — •Alexander Britting, Wolfgang Eyrich, Albert Lehmann, and Fred Uhlig — Physikalisches Institut, Universität Erlangen-Nürnberg

Microchannel plate photo multipliers (MCP-PMT) are the favored sensors for the DIRC detectors (Detection of Internally Reflected Cherenkov Light) of the PANDA experiment. The main reasons for this are their usability in high magnetic fields of up to $2T$, a time resolution of better than $\sigma = 50ps$ and a rate capability high enough to withstand a detected photon rate of about 200 $kHz\ cm^{-2}$ at the MCP-PMTs surface, which is anticipated at the average luminosity of $2 \cdot 10^{32}\ cm^{-2}s^{-1}$ in PANDA. Moreover, for the reconstruction of the Cherenkov angle using the planned optics for the barrel DIRC a spatial resolution of about 5 mm at the focal plane is needed .

Until recently the major drawback of MCP-PMTs was their limited lifetime which was by far not sufficient to stand the integrated anode charge, which is $\approx 5C/cm^2$ for the Barrel-DIRC and even more for the Disc-DIRC. However, the latest MCP prototype devices show a hugh step forward in this respect. The results of these lifetime measurements will be presented. The achieved values are meanwhile close to the PANDA requirements for the Barrel-DIRC.

- supported by BMBF and GSI -

HK 46.5 Di 17:45 WIL-A221

Charakterisierung verschiedener Multi-Anoden Photodetektoren im CBM-RICH Strahltest 2012* — •Sascha Reinecke für die CBM-RICH-Kollaboration — Bergische Universität Wuppertal

In Darmstadt an der GSI wird derzeit die Facility for Antiproton and Ion Research (FAIR) gebaut. Eines der dort geplanten Projekte ist das Schwerionenexperiment Compressed Baryonic Matter (CBM). Ziel ist die Vermessung des QCD-Phasendiagramms bei hohen Netto-Baryonendichten und moderaten Temperaturen sowie die Charakterisierung des Phasenübergangs hadronischer Materie zum Quark-Gluon Plasma. Eine wesentliche Komponente des CBM-Detektors ist ein Ring-abbildender Cherenkov-Detektor (RICH), in welchem das Cherenkov-Licht schneller Teilchen ($v > c_n = c/n$) über sphärische Spiegel ringförmig auf den Photodetektor abgebildet wird.

Im Rahmen einer im Oktober 2012 durchgeführten Teststrahlzeit am CERN-PS Beschleuniger konnten wichtige Informationen unter anderem für den Aufbau des Photodetektors des RICH gewonnen werden. Ein Ziel der Strahlzeit war die Charakterisierung von neuen Hamamatsu Multi-Anoden Photomultipliern (MAPMT) des Typs R11265 sowie von Micro-Channel-Plates (MCP) des Typs XP85012 der Firma Planacon sowie der jeweilige Vergleich mit den Hamamatsu H8500 MAPMTs. Wichtige Eigenschaften, die dabei von Interesse sind, sind z.B. die Anzahl an detektierten Photonen pro Cherenkov-Ring oder auch die Ringbreite. Wir berichten über erste Resultate der Analyse der bei dieser Strahlzeit gewonnenen Daten.

*gefördert durch BMBF 05P12PXFCE, und GSI

HK 46.6 Di 18:00 WIL-A221

Tests of Silicon Photomultipliers for NeuLAND — •Tobias Reinhardt[1], Daniel Bemmerer[2], Thomas Cowan[1,2], Zoltán Elekes[2], Klaus Heidel[2], Mathias Kempe[2], Marko Röder[1], Daniel Stach[2], and Andreas Wagner[2] — [1]Institut für Kern- und Teilchenphysik, Technische Universität Dresden — [2]Helmholtz-Zentrum Dresden-Rossendorf (HZDR)

For upcoming large-scale neutron time-of-flight detectors like NeuLAND at FAIR the use of photomultiplier tubes is still state-of-the-art for the detection of the scintillation light. However, recent developments in the field of Silicon Photomultiplier indicate that they may also be suitable for this type of application. $3 \times 3\,\mathrm{mm}^2$ prototypes from various manufacturers were tested with small scale scintillators and a Sr-90 source. Using inhouse developed preamplifier boards, first time resolution measurements with a 270 cm long NeuLAND BC-408 scintillation bar were carried out at the electron accelerator ELBE.

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HK 46.7 Di 18:15 WIL-A221

Characterization Measurements of the new APD-Based Readout of the CB Calorimeter at MAMI and ELSA — •Christian Honisch for the CBELSA/TAPS-Collaboration — HISKP, Nussallee 14-16, 53175 Bonn, Germany

One goal of the CBELSA/TAPS-Experiment is the measurement of double polarization observables in meson photoproduction, with the Crystal Barral calorimeter (CB) as the central detector component. In the current setup the trigger efficiency for purely neutral reactions

(e.g. $\gamma n \to n\pi^0$) is limited, because the CB is only integrated in the second level of the trigger. To improve the trigger efficiency for purely neutral channels, the existing PIN photo diode readout has to be replaced. The new avalanche photo diode (APD) readout will improve the signal to noise ratio and provide a timing signal fast enough, to include the CB in the first level trigger. The utilization of APDs allows the future operation of the CB calorimeter in a 2 T magnetic field.
A 3x3 matrix of CB crystals equipped with the new APD readout has been tested in the tagged photon beams at ELSA and MAMI. The results of these test measurements including energy resolution, time resolution, and active gain stabilization of the new APD readout electronics will be presented in this talk.
Supported by the Deutsche Forschungsgemeischaft (SFB/TR16) and Schweizerischer Nationalfonds.

HK 46.8 Di 18:30 WIL-A221

Wavelength Shifting Reflector Foils for Liquid Ar Scintillation Light — •Manuel Walter for the GERDA-Collaboration — Physik Institut, Universität Zürich, Schweiz

Liquid argon is used as a scintillator in several present and upcoming experiments. In Gerda it is used as a coolant, shielding and will be instrumented to become an active veto in Phase II. Its scintillation light has a wavelength of 128 nm, that gets absorbed by quartz. In order to measure the light using photo multiplier tubes (PMT) for cryogenic temperatures which have a quartz window, it is converted to longer wavelength by coated reflector foils. The conversion efficiency and stability of several such coatings was optimized using VM2000 and Tetratex separately as reflector foils. The efficiency has been measured in a liquid Ar set up build especially for this purpose. It employs a 3" low radioactivity PMT of type R11065-10 from Hamamatsu, the favorite photo sensor candidate to be used in Gerda.

HK 46.9 Di 18:45 WIL-A221

Wellenlängenkonvertierende Schichten auf Multianoden-Photomultipliern für den Einsatz im CBM Ring Imaging Cherenkov Detektor* — •Jan Kopfer für die CBM-RICH-Kollaboration — Bergische Universität Wuppertal

Der Ring Imaging Cherenkov Detektor (RICH) des Compressed Baryonic Matter Experiments (CBM) an der zukünftigen Beschleunigeranlage FAIR wird einen gasförmigen CO_2 Radiator verwenden. Wegen des $1/\lambda^2$ Verhaltens des Cherenkov-Spektrums und der guten Transmissionseigenschaften von CO_2 im ultravioletten Spektralbereich ist ein für kurzwellige Photonen sensitiver Photodetektor von Vorteil. Für den RICH Detektor wird der Einsatz von Multinanoden-Photomultiplieren (MAPMTs) in Betracht gezogen. Durch die Absorptionskante der Eintrittsfenster liegt die Quanteneffizienz der MAPMTs im Wellenlängenbereich von 200 nm bei etwa 10 %. Mit Hilfe von nasschemisch hergestellten Schichten aus organischen Molekülen, die UV-Photonen absorbieren und im sichtbaren Bereich über Fluoreszenz emittieren, kann die Detektoreffizienz gesteigert werden.

Wir stellen Untersuchungen zur Schichtdickenabhängigkeit vor, gehen auf den Unterschied zwischen tauchgezogenen und aufgedampften Schichten ein und zeigen Ergebnisse zur Photonenausbeute in einem RICH Prototypen während eines Strahltests am CERN PS.

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HK 46.10 Di 19:00 WIL-A221

The precision high voltage system of the KATRIN-experiment — •Oliver Rest for the KATRIN-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster

The KATRIN- (KArlsruhe TRItium Neutrino-) experiment will measure the endpoint region of the tritium β decay spectrum to determine the mass of the $\overline{\nu}_e$. To achieve sub-eV sensitivity the energy of the decay electrons will be analyzed using a MAC-E type spectrometer. The retarding potential of the MAC-E-filter up to -30 kV has to be monitored with a precision of 3 ppm.
To fine-tune the shape of the electric field inside the main spectrometer 46 different voltages can be applied to the wire electrode system inside the main spectrometer. All these channels are controlled by the KATRIN high voltage slow control system. The potential will be measured directly via two high precision voltage dividers, which were developed in cooperation with the PTB (Physikalisch-Technische Bundesanstalt) Braunschweig.

This talk will give an overview of the HV system and show first results of functionality tests performed at KIT (Karlsruher Institut für Technologie).

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