HK 55: Instrumentierung X

Time: Thursday 14:00–16:00 Location: HS2

Group Report HK 55.1 Thu 14:00 HS2

Status des Compressed Baryonic Matter (CBM) Experimentes — •Michael Deveaux für die CBM-Kollaboration — Goethe Universität Frankfurt am Main

Gefördert von BMBF, EU (FP7 HP2) und HIC for FAIR

Das Compressed Baryonic Matter (CBM) Experiment wird das QCD Phasendiagram im Bereich höchster baryonischer Dichten untersuchen. Hierbei sollen Signaturen des postulierten Phasenübergangs erster Ordnung zwischen der hadronischen Phase und dem Quark-Gluon-Plasma, sowie der kritische Endpunkt dieses Phasenübergangs identifiziert werden. Es wird darüber hinaus erwartet, dass die spontane Brechung der chiralen Symmetrie im von CBM erforschten Bereich des Phasendiagrams weitgehend aufgehoben wird.

Um diese Effekte nachzuweisen wird CBM im kompletten FAIR-Energiebereich Proton-Proton-, Proton-Ion-, und Ion-Ion-Kollisionen mit Hilfe eines umfangreichen Satzes an Observablen untersuchen. Dabei wird ein Schwerpunkt auf seltene Proben gelegt, die anderen Experimenten in diesem Energiebereich nicht zugänglich sind. Um diese Proben zu vermessen, wird ein Detektorsystem mit beispielloser Leistungsfähigkeit benötigt, das extrem schnelle, präzise und strahlenharte Detektoren mit einem freilaufenden Datenerfassungssystem und einer komplexen und flexiblen Echtzeitdatenanalyse verbindet. Der Status der Entwicklung dieses Detektorsytems wird erläutert und diskutiert.

HK 55.2 Thu 14:30 HS2

A differential MRPC prototype for CBM — •Ingo Deppner and Norbert Herrmann for the CBM-Collaboration — Physikalisches Institut, Universität Heidelberg

The key element providing hadron identification at incident energies between 2 and 45 AGeV in the future Compressed Baryonic Matter (CBM) spectrometer at FAIR is a time-of-flight wall placed at 10 m distance from the target covering the polar angular range from 2.5°-25° and full azimuth [1]. A full system ToF resolution better then 80 ps is required to achieve the necessary particle identification properties.

The existing conceptual design foresees a 120 m^2 big ToF-wall composed of Multi-gap Resistive Plate Chambers (MRPC) at which the outer-most part can be covered with float glass RPCs in a multi-strip configuration.

Based on in-beam tests at GSI at Darmstadt and COSY at Jülich we will present results on the performance reached with a fully differential multi-strip MRPC prototype with normal float glass developed at the Physikalisches Institut at University of Heidelberg.

Supported by EU/FP7 WP2; BMBF 06HD9121I.

[1] I. Deppner et al., The CBM time-of-flight wall, doi.org/10.1016 /j.nima.2010.09.165

HK 55.3 Thu 14:45 HS2

The CBM Time of Flight wall electronic readout chain — •Pierre-Alain Loizeau and Norbert Herrmann for the CBM-Collaboration — Physikalisches Institut, Universität Heidelberg, Germany

To achieve the particle identification goals needed by its physics program, the Compressed Baryonic Matter (CBM) experiment at FAIR requires a time resolution better than 80ps for its Time of Flight (ToF) wall. Because of Multi-gaps Resistive Plate Chambers (MRPC) properties, the limit in the total electronic chain resolution is then 40ps. To follow the general concept of the CBM detector readout, the wall also has to operate in a self-triggered mode, where each hit is readout independently and receives a time stamp.

The current demonstrator consists of the high bandwidth preamplifier discriminator PADI, the event driven TDC GET4, a clock system, a Readout controller with a dedicated firmware and the CBM software environment. To suppress common mode sensitivity, both detector and front-end are kept strictly differential. An external reference signal is additionally inserted in the data stream at the TDC level to allow an easier data reconstruction.

This chain was tested in beam with a differential MRPC at the COSY synchrotron in Jülich last November. The results from this test will be presented.

This work was supported by BMBF 06HD9121I.

HK 55.4 Thu 15:00 HS2

Testing a Prototype Ceramic MRPC at ELBE. — •Alejandro Laso, Richard Peschke, Rico Eissmann, Burkhard Kämpfer, Roland Kotte, Lothar Naumann, Daniel Stach, Christian Wendisch, and Jörn Wüstenfeld — Helmholtz-Zentrum Dresden Rossendorf

The use of multi-gap resistive plate chambers, MRPCs, has been proposed for the ToF wall in the future CBM experiment. Due to the high rates expected, $\approx 20kHz/cm^2$, it is necessary to develop new resistive materials capable of withstanding such rates [1, 2].

At the Helmholtz-Zentrum Dresden Rossendorf, various RPCs have been built with high resistive ceramic plates ($10^9 - 10^{10} Ohm \cdot cm$), up to areas of 20x20 cm^2, and tested with 30 MeV electrons at the superconducting electron accelerator facility ELBE.

In this talk, the test facility will be described as well as the results of our measurements of a MRPC prototype. The behavior of the detector, its efficiency, time resolution and rate capabilities will be discussed.

[1] L. Naumann, et al., Nucl. Instr. and Meth. A (2010), doi:10.1016/j.nima.2010.06.302

[2] L. Naumann, et al., Nucl. Instr. and Meth. A (2010), doi:10.1016/j.nima.2010.09.121

HK 55.5 Thu 15:15 HS2

Construction and test of a 2 m long MRPC-based prototype for the NeuLAND detector at FAIR — •Dmitry Yakorev[1], Daniel Bemmerer[1], Mircea Ciobanu[2], Zoltán Elekes[1], Mathias Kempe[1], Marko Röder[3], Manfred Sobiella[1], Daniel Stach[1], Andreas Wagner[1], and Kai Zuber[3] for the R3B-Collaboration — [1]Forschungszentrum Dresden-Rossendorf (FZD), Dresden — [2]GSI, Darmstadt — [3]TU Dresden

The NeuLAND detector at the R^{3}B experiment at the future FAIR facility in Darmstadt aims to detect fast neutrons (0.2-1.0 GeV) with high time and spatial resolutions ($\sigma_{\rm t}$<100 ps, $\sigma_{{\rm x},y,z}$<1 cm). The final detector should cover an area of 2 m x 2 m.

Based on the previous experience with 40 cm long prototypes, recently a 2 m long prototype of an multigap resistive plate chamber (MRPC) based solution for NeuLAND has been designed and constructed at FZD. Its efficiency for minimum ionizing particles and the time resolution have been tested using the single-electron mode of operation of the ELBE 40 MeV electron accelerator. The salient features of this full-size prototype, the results of the in-beam tests, and future work will be discussed. — Supported by BMBF (06DR9058I) and GSI FuE (DR-GROS and DR-ZUBE).

HK 55.6 Thu 15:30 HS2

Simulations for an MRPC-based solution for the NeuLAND detector at FAIR — •Zoltán Elekes[1], Daniel Bemmerer[1], Mathias Kempe[1], Marko Röder[2], Manfred Sobiella[1], Daniel Stach[1], Andreas Wagner[1], Dmitry Yakorev[1], and Kai Zuber[2] for the R3B-Collaboration — [1]Forschungszentrum Dresden-Rossendorf (FZD), Dresden — [2]TU Dresden

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HK 55.7 Thu 15:45 HS2

A novel scheme for suppresing signal cross-talk and ensuring signal integrity in Multi-Strip Counters — •Diego Gonzalez-Diaz for the R3B-Collaboration — TU, Darmstadt, Germany — GSI,

Darmstadt, Germany — Tsinghua University, Beijing, China

Signals induced in typical multi-strip Resistive Plate Chambers (RPCs) can travel up to 40 electrical lengths (40 times the characteristic signal wavelength) over densely packed multi-electrode parallel structures (typically on the number of 30-60 strips). This figure corresponds to a 100ps exponential signal travelling over 2 meters, surrounded by 15 anodes and 15-30 cathodes.

This makes RPCs easily the most extreme scenario for electrical signal transmission of all known detectors in Nuclear and Particle physics. Indeed, when reading out several strips simultaneously, a highly disperssive system arises, stemming fundamentally from modal dispersion and dielectric losses.

So far the topic of signal transmission in multi-strip RPCs has been always addressed on the basis of requiring the system to be 'impedance matched'. We will show that this requirement represents just a minor aspect of the transmission in an RPC structure. Indeed, best transmission is achieved for an impedance matched system only if the capacitive and inductive coupling are accurately balanced. Failing to do so properly results in a cross-talk increase up to a factor of 10 and signal degradation by up to 600 ps. Several simple ways to restore the capacitive-inductive balance are given and verified experimentally, allowing to largely improve the counter behavior with striking ease.