HK 4: Instrumentation

Zeit: Montag 14:00–16:00 Raum: P 2

Gruppenbericht HK 4.1 Mo 14:00 P 2

Development of the CBM Silicon Tracking System — •Johann M. Heuser for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt

The Silicon Tracking System (STS) is the central detector of the CBM experiment. Its task is the standalone trajectory reconstruction of the high multiplicities of charged particles originating from high-rate beam-target interactions, including momentum determination in a magnetic dipole field. The detector system shall be operational from the start of the CBM physics program at SIS-100, and later at SIS-300. The development of the STS is challenging. The silicon microstrip detectors must be radiation hard and operated at low temperature. Fast self-triggering front-end electronics is needed to send time-stamped detector data to an on-line event processor. High-density electronics boards are required to handle the large number of readout channels. A low-mass construction must be achieved avoiding the front-end electronics, cooling and cabling infrastructure in the aperture. In the presentation I will outline the conceptional layout of the STS, elaborate on the mechanical constraints, describe the expected radiation environment, and summarize the implications for the development of the detector components and their integration into the tracking system. Progress with the STS project will be shown, including the development of silicon microstrip detectors, front-end electronics and mechanical designs, as well as performance studies and in-beam tests of prototypes. Supported by EU-FP7 HadronPhysics3.

HK 4.2 Mo 14:30 P 2

Development of radiation hard silicon microstrip detectors for the CBM experiment — •Minni Singla for the CBM-Collaboration — Goethe University, Frankfurt, Germany

We aim to develop low noise radiation hard Double Sided silicon Strip Detectors (DSSDs) for the CBM Silicon Tracking System (STS). The neutron fluence is expected to reach $1{\times}10^{14}$ $n_{eq}cm^{-2}$ for some of the STS stations which puts us in the regime of LHC, high energy physics experiments. However our task is much more challenging since we use DSSDs, hence both detectors sides should be operating at such high fluences. In order to investigate the life time of DSSDs, it is imperative to extract charge collection efficiency (CCE) as a function of fluence for which one has to understand strip isolation in particular on the ohmic side. Hence we are exploring various isolation techniques, for example P-stop, P-Spray, Combined P-stop/P-spray (conventional techniques) and also a new isolation technique (Schottky barrier). Four detector designs having these isolation techniques have been fabricated at CiS, Erfurt and are being studied at GSI after neutron irradiation. Some interesting static and dynamic measurements have been done within our group to compare the isolation provided by Schottky barrier and conventional isolation techniques. A simulation model has also been developed which is able to reproduce the experimental observations. We plan to test these DSSDs in beam and to compare these isoltaion techniques in terms of CCE. Supported by EU-FP7 HadronPhysics3, HiC for FAIR and HGS-HIRe for FAIR.

HK 4.3 Mo 14:45 P 2

Radiation damage modelling for developing an operating scenario for the microstrip detectors in the CBM experiment — •Sudeep Chatterji for the CBM-Collaboration — GSI, Darmstadt, Germany

We present the first 3-D TCAD simulated results on Double Sided silicon Strip Detectors(DSSDs) using tools from SYNOPSYS. To determine the radiation hardness of these sensors, we have irradiated some of the prototypes at KRI Cyclotron facility, Russia. Our radiation damage model implemented in TCAD simulations is able to reproduce the irradiated data. Besides the static measurements, we have also extracted interstrip parameters relevant to understand strip isolation and cross-talk issues. Transient simulations have been performed to estimate the charge collection of irradiated sensors and the collected charge has been found to exactly mimic the variation of measured interstrip resistance with bias voltage. The extraced charge collection efficiency has been compared with test beam data. Controlled thermal annealing of irradiated DSSDs have been done to extract the beneficial and reverse annealing time constants and compared with Ziock parameterization. These time constants have been used to develop an operating scenario to understand the evolution of full depletion voltage with periods of annealing expected between the CBM data taking runs. Supported by EU-FP7 HadronPhysics3.

HK 4.4 Mo 15:00 P 2

A Multistrip-MRPC prototype for the CBM Time-of-Flight wall — •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 45 AGeV 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. The necessary particle identification capabilities require a 80 ps system time resolution at high efficiency and, simultaneously, a rate capability of up to 25 kHz/cm^2. The existing conceptual design foresees a 120 m^2 ToF-wall composed of Multi-gap Resistive Plate Chambers (MRPC) of which the outer-most part can be covered most likely with float glass RPCs in a multi-strip configuration. Based on in-beam tests at GSI/SIS18 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.

HK 4.5 Mo 15:15 P 2

Ceramic Resitive Plate Chambers for High Rate Environments — •Laso Garcia Alejandro, Kämpfer Burkhard, Kaspar Markus, Kotte Roland, Peschke Richard, Stach Daniel, Wendisch Christian, and Wüstenfeld Jörn for the CBM-Collaboration — Helmholtz Zentrum Dresden-Rossendorf

Multi-gap resistive plate chambers will be used to build the Time of Flight wall of the Compressed Baryonic Matter experiment (CBM) at FAIR with a time resolution better than 80 ps. The high fluxes expected at the innermost part of the detector, 20 x 10^3 cm^{-2} s^{-1} have made necessary the development of new materials capable of withstanding such fluxes.

At Helmholtz Zentrum Dresden-Rossendorf, several RPC prototypes of 10x10 cm^2 and 20x20 cm^2 have been built with ceramic plates with bulk resistivities in the range of 10^9-10^{10} Ohm cm [1]. They have been tested at the superconducting electron accelerator facility ELBE with 30 MeV electrons and at COSY, Jülich, with 2.7 Gev/c protons.

We will present characteristics of the ceramic electrodes and the latest results concerning the performance of these prototypes in electron and proton beams up to fluxes of 10^6 cm^{-2} s^{-1}.

[1] L. Naumann et al., NIMA 628(2011) 138-141

HK 4.6 Mo 15:30 P 2

A 200 cm × 50 cm large multigap resistive plate chamber based neutron detector — •Dmitry Yakorev[1], Marko Röder[2], Zoltán Elekes[1], Daniel Bemmerer[1], Thomas Cowan[1,2], Mathias Kempe[1], Manfred Sobiella[1], Daniel Stach[1], Andreas Wagner[1], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden — [2]TU Dresden

A prototype for a multigap resistive plate chamber (MRPC) based detector of 200 cm × 50 cm size for 1 GeV neutrons has been developed, built and tested. The principle of operation is (1) the conversion of the high-energy neutron to a charged particle in an iron converter, and (2) the detection of the charged particle in the MRPC. Experiments using the single-electron mode of operation of the ELBE 40 MeV electron accelerator showed that a time resolution of σ_t<100 ps was reached for minimum-ionizing particles, at nearly full efficiency. Extensive simulations show that it is feasible to construct a time-of-flight detector for GeV neutrons based on such a principle. — Supported by BMBF (06DR9058I) and GSI FuE (DR-GROS and DR-ZUBE).

HK 4.7 Mo 15:45 P 2

Simulation of a new endcap time of flight system for the BESIII experiment — •Matthias Ullrich, Hu Jifeng, Wolfgang Kühn, Sören Lange, Yutie Liang, Björn Spruck, and Marcel Werner for the BES III-Collaboration — 2 Physikalisches Insti-

tut, Universität Gießen

The BESIII experiment is located at the BEPC II collider in Beijing, China at the Institute for High Energy Physics, commonly known as IHEP. The symmetric e^+e^- experiment optimized for the investigation of τ and charm physics has allready collected over 220M J/Ψ, 106M $\Psi(2S)$, about $1 fb^{-1}$ $\Psi(3770)$ and 0.5 fb^{-1} $\Psi(4040)$ events. Finishing the next run period in June 2012 the total amount of J/Ψ / $\Psi(2S)$ events is expected to be 1 billion / 0.7 billion, respectively.

The actual endcap time of flight detector has a total time resolution of about 138 ps and is discussed to be replaced by a multigap resistive plate chamber (MRPC) providing a total time resolution of less than 80 ps.

We report about the implementation of such type of detector into the BESIII offline software system (BOSS) as replacement of the actual endcap time of flight detector. A detailed simulation code based on Geant4 as well as a full reconstruction code has been implemented and can easily be utilized for event simulation and reconstruction.