HK 54: HK+T Joint Session IX: Calorimeter

Zeit: Donnerstag 16:45–19:05 Raum: F 234

Gruppenbericht HK 54.1 Do 16:45 F 234

Final Design and Construction of the EMC for the PANDA Experiment — •Miriam Kümmel for the PANDA-Collaboration — Institut für Experimentalphysik I, Ruhr-Universität Bochum

The PANDA experiment is a key experiment at the future accelerator facility FAIR, under construction in Darmstadt, Germany. Open questions in hadron physics will be addressed by studying collisions of an antiproton beam with a fixed target at antiproton momenta between 1.5 GeV/c and 15 GeV/c.

An electromagnetic calorimeter (EMC) is used to determine the energy of electrons, positrons and photons. This information is essential to fully reconstruct the 4-momenta of all collision products. The homogeneous calorimeter is equipped with lead tungstate scintillation crystals, which were chosen due to their fast signal decay time, compactness as well as radiation hardness. The EMC is subdivided into a barrel part and two endcaps. The forward endcap will be exposed to the highest hit rates and radiation dose which puts very high demands on the performance of this subdetector. To increase the light yield, the electromagnetic calorimeter will be operated at -25°C.

This talk will provide an overview of the final design and construction status of the EMC. The mechanical support structure, the cooling system, the assembly of calorimeter subunits, the matching of crystals, photosensors and preamplifiers to achieve a homogeneous signal yield, the signal digitization as well as environmental and optical monitoring systems will be presented.

This project is supported by the BMBF.

HK 54.2 Do 17:15 F 234

Studies on 2015 testbeam data of a highly granular hadron calorimeter prototype — •Sascha Krause for the CALICE-D-Collaboration — Institut für Physik, Johannes Gutenberg-Universität Mainz, Germany

An Analog Hadronic Calorimeter (AHCAL) is being developed within the CALICE collaboration for the planned International Linear Collider (ILC). To achieve the required energy resolution for jets, the Particle Flow Algorithm has been proposed for the event reconstruction. One major requirement for this algorithm is a highly granular calorimeter. Therefore, about 8 million detector units consisting of scintillator tiles and silicon photomultipliers (SiPMs) will be installed in the final HCAL design. During a CERN SPS testbeam in 2015, data with a prototype consisting of up to 11 layers of HCAL Base Units (HBU) was collected using muon, electron and pion beams. A special feature was the first automatically assembled HBU including 144 scintillator tiles and surface mounted SiPMs. After several calibration steps and event selections, the testbeam data can be compared to a MC simulation of the prototype. First results of this comparison will be presented, testing the performance of the prototype.

Gruppenbericht HK 54.3 Do 17:30 F 234

Sensors for the CMS High Granularity Calorimeter — •Andreas Maier — CERN, Genf, Schweiz

The Particle Flow Algorithm (PFA) is increasingly used in particle physics as a powerful tool to improve jet energy resolution. Recent technology advances allow to fully exploit PFA by combining precise tracking with fine-grained calorimetry. The CMS experiment is currently developing high granularity calorimeter endcaps for its HL-LHC upgrade (CMS HGCAL). The electromagnetic part, as well as the first layers of the hadronic part, foresees silicon sensors as the active material. This technology is similar to the silicon-based ECAL developed in the framework of the Linear Collider by the CALICE collaboration. In this talk the current status of the HGCAL silicon sensor development is presented. First results of single diode measurements are shown, as well as tests of full 6-inch hexagonal sensor wafers with 135 cells in the laboratory and in beam tests.

HK 54.4 Do 17:50 F 234

The CMS High-Granularity Endcap Calorimeter: Test Beam and Sensor Tests at CERN — Martin Erdmann[1], •Thorben Quast[1,2], and Eva Sicking[2] — [1]Physics Institute IIIA, RWTH Aachen, Germany — [2]CERN, Geneva, Switzerland

Fine-grained calorimetry has been explored for future e+e- experiments at ILC and CLIC for several years. CMS is developing high-granularity endcap calorimeters (HGCAL) for its HL-LHC upgrade. After a quick overview to the CMS HGCAL project, the talk summarises results from silicon sensor testing and test beam experiments carried out at CERN in 2016. In this context, an energy reconstruction approach based on convolutional deep neural networks is presented to assess the image-like character of the recorded data. Its application for the HGCAL is evaluated and compared to standard energy reconstruction algorithms.

HK 54.5 Do 18:05 F 234

The crystal Zero Degree Detector at BESIII — Achim Denig[1], Peter Drexler[1], •Brice Garillon[1], Leonard Koch[2], Wolfgang Kühn[2], Sören Lange[2], Werner Lauth[1], Yutie Liang[2], Torben Rathmann[1], and Christoph Redmer[1] for the BESIII-Collaboration — [1]Johannes Gutenberg Universität Mainz — [2]Justus-Liebig-Universität Gießen

The BESIII experiment based at the BEPCII e^+e^- collider (Beijing, China) is investigating physics in the charm-τ region. Processes in which the particles emission peaks towards small polar angles, such as photons from initial state radiation (ISR) or scattered leptons from $\gamma\gamma$ collisions, are detected with limited efficiency.

In order to improve their detections, we propose two small calorimeters placed at the very forward/backward angles. Each detector is composed of two arrays of 4x3 rectangular-shaped scintillating LYSO crystals, separated by a gap. The scintillation light will be collected by silicon photomultipliers (SiPMs) and the signals will be digitized using sampling Analog-to-Digital Converters (ADC).

In this contribution, we present a performance study of the detectors, based on a Geant4 simulation of BESIII, as well as the results from the tests of the LYSO crystals and the read-out electronics using radioactive sources and electron beams at the MAMI accelerator.

This work is supported by the DFG under contract No. CRC 1044.

HK 54.6 Do 18:20 F 234

Automatic assembly and test of CALICE second generation SMD readout boards — •Phi Chau for the CALICE-D-Collaboration — Johannes Gutenberg-Universität Mainz

The CALICE collaboration is developing an analog hadronic sampling calorimeter (AHCAL) for the International Linear Collider (ILC) using scintillator with silicon photomultiplier (SiPM) readout. Due to an optimization of the design for particle flow algorithm, small detection units are necessary. This leads to a high number of channels for the AHCAL (in total around 8.000.000) which represents a challenge for the construction and calibration in a suitable time window. To assure a fast assembly of the detection units the design of the readout board are optimized for an automatic assembly process. This presentation will show the automatic assembly of this optimized second generation readout boards (6 boards x 144 channels) and the very good performances of these boards measured in an integrated cosmic ray test stand. Also preparations for the 2017 assembly run of a large number of readout boards (with around 20.000 channels) are shown.

HK 54.7 Do 18:35 F 234

Response of a prototype for the PANDA barrel EMC to tagged photons in an energy range from 50 MeV to 800 MeV — •Benjamin Wohlfahrt[1], Kai-Thomas Brinkmann[1], Stefan Diehl[1], Christopher Hahn[1], Markus Moritz[1], Rainer Novotny[1], Christoph Rosenbaum[1], Andrea Wilms[2], and Hans-Georg Zaunick[1] for the PANDA-Collaboration — [1]II. Physikalisches Institut, Justus Liebig Universität Gießen — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

The PANDA experiment will investigate physics in the strongly interacting regime via antiproton - proton annihilations. The PANDA detector will comprise a target spectrometer as well as a dedicated forward spectrometer. In the target region, a barrel-shaped electromagnetic calorimeter with end-caps on both sides will be used. It will play a major role by detecting photons utilizing about 15500 PbWO4 crystals. A subsection of the barrel EMC has been implemented as a prototype, consisting of 120 crystals of which each is read out by two independent Avalanche Photo Diodes. To ensure that the Barrel-EMC fulfills all requirements, the response of this prototype has been tested with tagged photons in an energy range from 50 MeV to 800 MeV at

the MAMI-facility in Mainz. This contribution will report about the energy resolution achieved with a 5x5 array of crystals within the prototype and will compare different calibration studies. In addition, the matching procedure of the two APDs for each crystal and their cross-calibration will be discussed. *The Project is supported by BMBF, GSI and HIC for FAIR

HK 54.8 Do 18:50 F 234

Megatile studies and development for the mass assembly of a highly granular hadron calorimeter — •Yong Liu for the CALICE-D-Collaboration — Institut für Physik, Johannes Gutenberg-Universtät Mainz, 55099 Mainz, Germany

A large technological prototype of a highly granular sampling hadron calorimeter (HCAL) based on scintillator tiles and silicon photomultipliers (SiPMs) is being developed within the CALICE collaboration. We have developed a novel design of scintillator tiles directly coupled to surface-mounted SiPMs, which addresses the challenge from automated mass assembly of around 8 million channels of the final HCAL detector. This design has been realized in 7 HCAL readout boards with a total of 1008 channels have been successfully built via mass assembly, and this design has been adopted as the baseline design for the large prototype construction. To further simplify mass assembly, various designs based on large scintillator plates with embedded structures for optical segementation ("megatiles") have been developed. Simulation studies as well as prototype developments and measurements will be presented in detail.