T 86: Kalorimeter

Zeit: Donnerstag 16:30–19:05 Raum: Z6 - SR 2.002

Gruppenbericht T 86.1 Do 16:30 Z6 - SR 2.002
Overview of production and tests for the CALICE AHCAL technological prototype — •Phi Chau for the CALICE-D-Collaboration — Johannes Gutenberg-Universität Mainz, Institut für Physik

The CALICE collaboration is studying several calorimeter concepts, each one optimized for a usage of particle flow algorithm, for a future linear collider detector. One of these concepts, the analog hadronic calorimeter (AHCAL), is using a sandwich design with tungsten or steel absorber plates. Due to a particle flow algorithm optimized design, small detection units are needed. This results in a large number of channels (around 8.000.000) which is realized by a system composed of small scintillator tiles each read out by a silicon photomultiplier (SiPM). Construction and calibration within a suitable time window are challenging and have to be optimized. Also the design of the components has to be adjusted for mass assembly.
In 2017 the production and testing of a large technological prototype with 160 electronics boards and around 23.000 channels was started. This presentation will show an overview of the technological prototype and its production. Also various test results related to performance and quality checks will be presented.

T 86.2 Do 16:50 Z6 - SR 2.002
AHCAL scintillator tile production — •Stephan Martens, Erika Garutti, and David Lomidze for the CALICE-D-Collaboration — Institute of Experimental Physics, Hamburg University

The CALICE collaboration develops a prototype particle flow calorimeter with excellent spatial and time resolution to investigate hadronic shower development with $3{\times}3{\times}0.3$ cm^3 granularity. The single channel of the AHCAL (analog hadronic calorimeter) prototype is a plastic scintillator tile wrapped in reflector foil and coupled to a silicon photomultiplier. The complete prototype requires about 24000 single channels, arranged in 40 sampling layers of about 0.5 m^2 in size.

A Light Yield (LY) of about 16-18 photoelectrons per minimum ionizing particle, with a spread lower than 10% can be reached if the production of the single channels is automatized and accurately controlled.

We present the automatized production of AHCAL tiles and their characterization in terms of LY.

T 86.3 Do 17:05 Z6 - SR 2.002
Hadronic energy reconstruction in the CALICE combined calorimeter — •Yasmine Israeli for the CALICE-D-Collaboration — Max Planck Institute for Physics, Munich, Germany

The CALICE collaboration develops highly granular calorimeters for present and future collider experiments. A system consisting of a Si-W electromagnetic calorimeter, a scintillator steel hadronic calorimeter and a tail catcher was tested with hadronic test-beams at CERN and Fermilab.

This contribution will discuss the calibration and the energy reconstruction for the combined configuration, which has to account for the differing geometry and different readout technology in the subsystems. The study includes the test beam data and Geant4 simulations with different hadronic physics models. The data were reconstructed with the standard reconstruction and with the software compensation method, which uses the information of the local energy of each detector cell.

The energy resolutions obtained with the combined system are comparable to the ones achieved for showers starting only in the hadronic calorimeter, demonstrating the success of the inter-calibration of the different subsystems. In addition,the software compensation-based algorithm improves the hadronic energy resolution by up to 30% compared to the standard reconstruction.

T 86.4 Do 17:20 Z6 - SR 2.002
Time Measurements with the CALICE Analog Hadronic Calorimeter — •Christian Graf für die CALICE-D-Kollaboration — Max-Planck-Institut für Physik, München, Deutschland

One of the main requirements of particle detectors at future linear e^+e^--colliders as ILC or CLIC is a jet energy resolution of 3-4%. To achieve this goal, the detector design heavily relies on the Particle Flow paradigm. Highly granular calorimeters with a fine spacial resolution play a key role in this approach.

The CALICE collaboration is developing concepts for such highly granular calorimeters. One of them, the analog hadronic calorimeter (AHCAL), is a sampling calorimeter using 3x3 cm^2 scintillator tiles as active material, read out by silicon photomultipliers (SiPMs) and steel or tungsten plates as absorbers. In order to investigate the performance of the used technologies and to prove the feasibility of constructing this type of calorimeters, a series of test-beam campaigns was carried out with a "technological prototype". The technological prototype is constructed with front-end chips integrated in the active layers and the design is scalable to a full detector.

This talk will focus on the time analysis of data taken in test-beam campaigns in 2015 and 2017 at SPS at CERN. Special emphasize will be put on the time structure of hadronic showers with a prototype in a large tungsten stack. Additionally, the influence of a 1.5T magnetic field on the detector performance will be investigated.

T 86.5 Do 17:35 Z6 - SR 2.002
The CMS High Granularity Calorimeter for the HL-LHC: Online Trigger and Particle Identification — •Luca Mastrolorenzo — RWTH III. Physikalisches Institut A, Aachen, Germany

The HL-LHC will pose significant challenges for radiation tolerance and event pileup on detectors, especially for forward calorimetry, hallmarking the issue for future colliders. As part of the Phase-II upgrade, the CMS collaboration envisages the complete replacement of the endcap calorimeters with the HGCAL detector. Based on silicon technology, HGCAL features unprecedented transverse and longitudinal segmentation. This will improve the event reconstruction, allowing to maximally exploit the particle-flow (PF) calorimetry. The intrinsic high-precision timing capabilities of the silicon sensors will add an extra dimension to the event reconstruction, especially in terms of pileup rejection. In parallel, the hardware (L1) trigger system will be subject to a deep upgrade to increase the sustainable rate up to O(750 kHz). A main challenge is represented by the design of the HGCAL L1 trigger architecture: it must be capable to exploit the high granularity to enhance the pileup rejection and particle identification, whilst still achieving good energy resolution and pioneering PF-based techniques at L1.

T 86.6 Do 17:50 Z6 - SR 2.002
Beam-tests of prototype modules for the CMS High Granularity Calorimeter with electrons and hadrons at CERN — •Thorben Quast — CERN, Geneva, Switzerland — Physics Institute IIIa, RWTH Aachen University, Germany

As part of its HL-LHC upgrade program, CMS is developing a High Granularity Calorimeter (HGCAL) to replace the existing endcap calorimeters. The HGCAL will be realised as a sampling calorimeter, including 28 layers of silicon pad and 24 layers of silicon+scintillator detectors interspersed with metal absorber plates. Starting from 2016, prototype modules, based on 6-inch hexagonal silicon pad sensors with pad areas of 1.0 cm2, have been constructed. In 2017, beam tests of different sampling configurations made from these modules have been conducted at CERN's SPS using beams of charged hadrons and electrons with momenta from 20 to 350 GeV/c. The setup was complemented with CALICE's AHCAL prototype, a scintillator based sampling calorimeter, mimicking the proposed design of the HGCAL's back part. Most importantly, the new Skiroc2-CMS readout ASIC has been used which will allow for the study of its timing capabilities in practice. This talk summarises the test beam efforts in 2017. In particular, the setups and the encountered challenges are discussed. Secondly, preliminary results, including gain characterisation, calibration with minimum ionising particles and energy reconstruction performance of electron and hadron induced showers are shown. Finally, a first impression on the timing capabilities is given.

T 86.7 Do 18:05 Z6 - SR 2.002
Muon Pion Separation for the $K^+ \to \pi^+\nu\bar{\nu}$ Measurement with the NA62 Experiment — •Riccardo Aliberti — Johannes Gutenberg University - Mainz

The ambitious goal of the NA62 experiment is to achieve a direct

measurement of the $K^+ \to \pi^+\nu\bar{\nu}$ branching ratio with an accuracy around 10%. This decay has a theoretical BR of $(8.4 \pm 1.0) \times 10^{-11}$ with a single track detectable: the π^+.
The main decay channels of charged kaons have rates several orders of magnitude larger than those for the signal. For this reason the presence of a very efficient veto system to reject background events is mandatory.
The discrimination between muons and pions is one of the central issues for the measurement of the $K^+ \to \pi^+\nu\bar{\nu}$ decay. In this context the measurement of the energy deposit inside the hadron calorimeter is one of the most important inputs to the pion-muon separation. This talk presents the procedure of the absolute calibration of the NA62 hadron calorimeter with particular focus on the usage of stopped high-energetic muons to calibrate the electromagnetic response of the detector.

T 86.8 Do 18:20 Z6 - SR 2.002

MicroMegas for measuring the direction of electromagnetic showers — •Stefan Kormannshaus — Johannes Gutenberg-Universitaet Mainz

The SHiP experiment, which is planned at the CERN SPS, aims to measure new, weakly interacting non-Standard Model particles. To reconstruct decays of neutral particles like axions into photons, not only the energy of the photons, but also their direction needs to be measured. The electromagnetic calorimeter is therefore planned to be equipped with layers of high-resolution MicroMegas detectors within the production, to measure the position of the electromagnetic showers inside the calorimeter. MicroMegas have general advantages for this purpose, like having a sufficiently precise spatial resolution ($\sim 50\mu m$) and a small longitudinal extent of only a few cm. In this talk we present simulation studies of different calorimeter designs with high-precision MicroMegas layers and of the achievable angular resolution of electromagnetic showers.

T 86.9 Do 18:35 Z6 - SR 2.002

Study of performance of electro-magnetic calorimeter of SHiP experiment — •Gia Khoriauli — Johannes Gutenberg-Universität Mainz, Staudingerweg 7, 55128 Mainz, Rheinland-Pfalz

The SHiP experiment is a new fixed target experiment proposed at the CERN SPS accelerator facility to search for very weakly interacting particles with masses of $\mathcal{O}(10)$ GeV or below and long lifetimes. The goal is to accumulate 2×10^{20} 400 GeV/c protons on target extracted from the SPS during five years of operation. The experiment has a potential to explore the parameter space regions of hidden-sector particles originating from charm and beauty meson decays not reachable by existing or planned experiments in the near future. The electromagnetic calorimeter will be one of the key detectors of the experiment. Its main purpose is to measure energies as well as directions of photons coming e.g. from decays of axion-like particles with high detection efficiency. The design concepts and performance studies of the SHiP electro-magnetic calorimeter are reviewed.

T 86.10 Do 18:50 Z6 - SR 2.002

Simulation and Hardware Studies on a Highly Granular Electromagnetic Calorimeter for the DUNE Near Detector — •Lorenz Emberger and Frank Simon — Max-Planck-Institut für Physik

The near detector of the Deep Underground Neutrino Experiment (DUNE) will play an important role in search for leptonic CP violation and other neutrino oscillation measurements, in addition to providing a rich physics program on its own. It will consist of different subdetectors, among them an electromagnetic calorimeter to reconstruct neutral pions, photons and electrons. A key aspect of the calorimeter performance will be its capability of locating the point of origin of neutral pions, to allow their association to neutrino interactions observed in the tracking elements of the near detector. We present a GEANT4 simulation study of an electromagnetic calorimeter inspired by the highly granular scintillator / SiPM based calorimeters of the CALICE collaboration, highlighting the benefits of granularity on neutral pion reconstruction and the influence of specific geometry choices for the detector. Results of ongoing laboratory studies of scintillator elements that may deliver the required granularity will also be presented.