T 17: Kalorimeter

Zeit: Montag 16:00–18:30 Raum: ST 1

T 17.1 Mo 16:00 ST 1

Analyse von Elektronenschauern in einem hadronischen Kalorimeter-Prototypen für einen zukünftigen Linearbeschleuniger — •Anna Rosmanitz für die CALICE-D-Kollaboration — Johannes Gutenberg-Universität Mainz

Die CALICE-Kollaboration entwickelt Kalorimeter für zukünftige e^+-e^- Linearbeschleuniger wie den ILC. Diese Kalorimeter sollen eine Energieauflösung von $30\%/\sqrt{E[GeV]}$ erreichen. Hierfür kommen Particle Flow Algorithmen zum Einsatz, die die Rekonstruktion von Jets durch die Identifikation einzelner Teilchen verbessern. Um sie anwenden zu können, müssen die Kalorimeter hochgranular sein. Die Zeitstruktur des Strahls am ILC (1 ms Strahl, 199 ms Pause) ermöglicht die Anwendung des sogenannte Power Pulsings, bei dem das Auslesesystem nicht durchgängig betrieben, sondern nur aktiviert wird, wenn ein Teilchenpaket ankommt. Dadurch reduziert sich der Energieverbrauch und die Notwendigkeit von Kühlsystemen. Ein von CALICE entwickelter und in einer Massenfertigung hergestellter hadronischer Kalorimeterprototyp, mit Szintillatoren-Kacheln ausgelesen von Silizium-Photomultipliern, wurde in mehreren Teststrahlkampagnen 2018 am CERN-SPS mit Elektronen, Muonen und Pionen getestet. In diesem Vortrag wird die Analyse der Elektronendaten mit besonderem Augenmerk auf die Schauerform und den Vergeich mit Simulationen vorgestellt.

T 17.2 Mo 16:15 ST 1

Study of High Resolution, DOI-Capable Gamma Detectors — •Federica Dematt̀è, Thomas Dey, Pierre Gebhardt, Nicolas Gross-Weege, Florian Müller, David Schug, Björn Weissler, Laiyin Yin, and Volkmar Schulz — Department of Physics of Molecular Imaging Systems, Institute of Experimental Molecular Imaging, RWTH Aachen University, Aachen, Germany

In gamma detectors, high spatial resolution can be achieved using pixelated scintillators. A specific segmentation of the scintillator on both the x- and y-axis allows the three dimensional reconstruction of the light emission point in the crystal. Thus, the position of the incoming gamma can be estimated precisely. The prerequisite for this reconstruction is the precise alignment of the detector components. Without a careful match between a Silicon Photomultiplier (SiPM) array and the crystal, it is not possible to reconstruct the Depth Of Interaction information needed for a sub-millimeter spatial resolution.

This talk will introduce a compact pixelated gamma calorimeter formed by a PDPC DPC-3200 sensor tile, a pixelated scintillator and a lightguide, as e.g. used in the European Hypmed project. Furthermore, the alignment tool used for the high precision mounting of the detector components will be presented.

T 17.3 Mo 16:30 ST 1

Evaluation of Scintillator Tiles and SiPMs for highly granular Calorimeters — •Malinda de Silva, Frank Simon, and Marco Szalay — Max-Planck-Institut für Physik, Föhringer Ring 6, 80805 München

Plastic scintillator tiles and Silicon photomultipliers (SiPMs) are key elements of highly granular imaging calorimeters being developed for HL-LHC upgrades and for experiments at future colliders and in neutrino beams. The light yield of the combination of the scintillator and the SiPM, as well as the spatial response uniformity of the scintillator elements, are crucial for the overall performance of the detectors. In this contribution we discuss detailed studies of different scintillator tile geometries and other scintillator elements, performed with a uniformity scanning setup based on a radioactive source, as well as the observed light yield of tiles obtained with standard and with high dynamic range Hamamatsu MPPCs.

T 17.4 Mo 16:45 ST 1

Muon simulation studies of the CALICE AHCAL 2018 Technological Prototype test beam data — •Saiva Huck for the CALICE-D-Collaboration — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

The Analog Hadron Calorimeter (AHCAL) is a highly granular hadron calorimeter with 8 million single channels designed by the collaboration Calorimeter for Linear Collider Experiment (CALICE) to be used in a future high precision Particle Flow collider experiment. One single channel is made up of one $30\times30\times3\,\mathrm{mm}^3$ plastic scintillator tile which is read out via one Silicon Photomultiplier (SiPM).
A technological prototype of the AHCAL consisting of 38 active layers alternating with 1.7 cm thick steel absorber plates has been constructed and taken to test beam at the CERN SPS in 2018.
This study focuses on the comparison of characteristics of muon runs used for MIP calibration in both test beam data and the corresponding digitized Geant 4 simulation. Various properties including hit energies and number of hits per event are compared.
Overall, the distributions for the muons in data and simulation are in good agreement which validates the digitization procedure for low deposited energies.

T 17.5 Mo 17:00 ST 1

Energy Calibration and First Results of the CERN 2018 Test Beams of the Large AHCAL Technological Prototype — •Daniel Heuchel for the CALICE-D-Collaboration — Deutsches Elektronen-Synchrotron (DESY), Hamburg, Deutschland

The Analog Hadronic Calorimeter (AHCAL) is a highly granular calorimeter developed by the CALICE collaboration for a future e^+e^- linear collider. Driven by the Particle Flow approach the achievement of jet energy resolutions of 3-4% for jet energies between 40-500 GeV is desired. The detector concept is based on 3x3 cm^2 scintillating tiles combined with a read-out by Silicon Photomultipliers (SiPM). In total 21888 channels on 38 active layers, alternating with steel absorber plates, build up the latest generation of the AHCAL technological prototype. This prototype features fully integrated readout electronics, scalable to a full collider detector, operable in power pulsing mode to reduce power consumption. In 2018 three beam test periods at the CERN SPS have been performed with muon, electron and pion beams for the validation of the calibration of the detector and to study hadronic showers.

In this contribution, we will present first results of this beam test periods with the focus on the energy calibration of the detector with muon data and the comparison to simulation. Furthermore, comparative studies of calibration quantities will be discussed in terms of uniformity and stability during the different beam test periods and for different detector operation modes.

T 17.6 Mo 17:15 ST 1

Particle identification methods for the CALICE highly granular SiPM-on tile calorimeter. — •Vladimir Bocharnikov for the CALICE-D-Collaboration — Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — NRNU "MEPhI", Moscow, Russia

The Analog Hadronic Calorimeter AHCAL is a highly granular sampling calorimeter developed by the CALICE collaboration for the future International Linear Collider (ILC). It is designed in accordance with the requirements of the Particle Flow Algorithm to achieve a good jet energy resolution. The AHCAL engineering prototype consists of $\sim$ 22000 channels equipped with $3 \times 3\ cm^2$ scintillator tiles with individual readout by silicon photomultipliers. The prototype was tested with muon, electron and pion beams at the CERN SPS facilities. To classify events according to the initial particle type, we apply cut-based and multivariable analysis methods using topological parameters of events. Monte-Carlo simulations are used for tuning and testing the classification methods. In this contribution we will demonstrate the performance of AHCAL technological prototype for particle identification using different methods.

T 17.7 Mo 17:30 ST 1

Advanced Hadronic Energy Reconstruction in the CALICE AHCAL Technological Prototype — •Christian Graf for the CALICE-D-Collaboration — Max-Planck-Institut für Physik, München, Deutschland

The CALICE collaboration is developing concepts for highly granular calorimeters for future e^+e^--colliders, such as ILC or CLIC. 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. A series of test-beam campaigns was carried out with a technological prototype in order to prove the feasibility of the technology for such a device. The technological prototype is constructed with

front-end chips integrated in the active layers and the design is scalable to a full detector. A new feature compared to previous prototypes is the capability to provide hit time information for each calorimeter cell.

The high granularity of the prototype allows for advanced energy reconstruction methods. This contribution will discuss wether the hit time information can be used to enhance the energy reconstruction using simulated data. Additionally, methods will be explored in order to further improve the energy reconstruction incorporating several event variables in the energy reconstruction.

T 17.8 Mo 17:45 ST 1

Gain Calibration and SiPM Saturation studies with the CALICE AHCAL — •Olin Lyod Pinto for the CALICE-D-Collaboration — Deutsches Elektronen-Synchrotron (DESY), Notkestraße 85, 22607 Hamburg Hamburg — Universität Hamburg, Mittelweg 177, 20148 Hamburg

ABSTRACT: An analog hadron calorimeter (AHCAL) prototype of $\sim$ 4 nuclear interaction length thickness has been developed and constructed by members of the CALICE Collaboration. The prototype consists of a 38-layer sampling structure of steel absorber plates and highly segmented active layers consisting of $21,888$ channels of $30 \times 30 \times 3$ mm^3 scintillator tiles read out by Silicon Photomultipliers (SiPM). The prototype is equipped with a LED system capable of determining SiPM quantities. The LED signals are used to determine the gain of the SiPMs. With the gain measurements, the homogeneity of the detector is studied, the stability and temperature dependence during the testbeam periods are monitored. The amplitudes measured in physics events need to be corrected for the non-linear behavior of the SiPMs due to their limited number of pixels. This saturation effect is studied compared to the data. The study is performed using data collected with the AHCAL at CERN SPS test beams 2018.

T 17.9 Mo 18:00 ST 1

Tile assembly and calibration of CALICE AHCAL technological prototype and tests of Megatile prototypes — •Phi Chau and Sebastian Ritter for the CALICE-D-Collaboration — Johannes Gutenberg-Universität Mainz, Institut für Physik

Several calorimeter concepts are under development by the CALICE collaboration, each of them is optimized for Particle Flow Algorithm. The design of the Analog Hadronic CALorimeter (AHCAL), a sampling calorimeter for a future electron-positron collider, is realized with around 8,000,000 scintillator tiles each wrapped in reflector foil and read out by a silicon photomultiplier (SiPM). Because of these large numbers of channels, an optimization of construction, assembly and calibration is necessary. In 2017/18 the AHCAL-groups have constructed a technological prototype with around 22,000 channels. The tile assembly has been realized with an automated gluing and placing procedure and a light yield calibration with cosmics has been performed as part of a quality check. Also, an alternative scintillator concept, the Megatile, was developed at the University of Mainz for further simplification of the assembly. A full-scale prototype plate with 12 x 12 channels, each separated with tilted reflective TiO_2 trenches, was produced and tested. Results of this and previous prototypes show comparable light yields to those of the individually wrapped scintillator tiles and an adequate low channel to channel crosstalk.

T 17.10 Mo 18:15 ST 1

Energy resolution of the AHCAL and comparison of electron data with simulation. — •Amine Elkhalii for the CALICE-D-Collaboration — Bergische Universität Wuppertal

The CALICE Collaboration develops calorimeters for a future e^+e^- linear collider. Theses calorimeters have a high granularity in order to allow Particle Flow Analysis and to achieve high jet energy resolutions of $3-4\%$. One of these concepts is the Analog Hadronic Calorimeter (AHCAL), which is based on $3*3cm^2$ scintillator tiles with individual Silicon Photomultiplier readout. A large technological prototype of 38 layers with $1.7cm$ steel absorber ($\sim 4\lambda$) has been constructed and commissioned by several institutes. The prototype has been installed in H2 beam line at the CERN SPS, where the test beam has been performed during two periods May and June 2018. Around 8 to 10 $*10^7$ events from muon, electron and pion has been collected with different energy ranges. Comparing the longitudinal electron shower profiles data with simulation is one of the important study for the calibration and performance of the detector. This talk will focus on energy resolution of the AHCAL and comparison of electron data with simulation.