T 94: Kalorimeter III (SiPM)

Zeit: Donnerstag 16:45–18:30 Raum: VMP6 HS E

T 94.1 Do 16:45 VMP6 HS E

Optimization of a readout board for mass assembly and light yield measurements with a cosmic ray test stand — •Phi Chau for the CALICE-D-Collaboration — Johannes Gutenberg-Universität Mainz, Institut für Physik, Germany

We have built a readout board prototype, equipped with SiPMs, scintillators and readout electronics for an highly granular calorimeter. The design was optimized for mass assembly due to about 8 million channels in the final detector. The prototype showed good performance in several test beams and in a cosmic ray test stand, which was built to characterize the MIP response of these kinds of boards. We show an overview of the cosmic ray test stand and measurement results for the readout board and plans for an improved 2nd generation prototype.

T 94.2 Do 17:00 VMP6 HS E

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

To achieve excellent jet energy resolution, a highly granular hadronic calorimeter is being developed within the CALICE collaboration. Therefore, about 8 million detector units consisting of scintillator tiles and silicon photomultipliers (SiPMs) will be installed in the final HCAL design. The usage of surface-mounted (SMD) SiPMs allows an automated mass assembly. During CERN SPS testbeam 2015, data for a prototype consisting of up to 11 layers of HCAL base units (HBU) was collected using electron, muon and pion beams. One of the layers was equipped with the first SMD HBU. Results and performance, especially of the SMD HBU will be presented.

T 94.3 Do 17:15 VMP6 HS E

Studies on scintillator tiles and surface-mounted SiPMs for the mass assembly of a highly granular hadron calorimeter — •Yong Liu for the CALICE-D-Collaboration — Institut für Physik, Johannes Gutenberg-Universität Mainz, Mainz, Germany

A 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. Driven by the need of an automated mass assembly of around 8 million channels of the final HCAL, we developed a design of scintillator tiles directly coupled to surface-mounted SiPMs and successfully built an HCAL readout unit with 144 channels via mass assembly. Results of extensive performance tests will be shown. Further studies on the characterisation of a novel SiPM with extremely low noise as well as tile design optimisations for the next generation of HCAL readout units will also be presented.

T 94.4 Do 17:30 VMP6 HS E

Scintillator tiles with SiPM readout for calorimetry and fast timing in SuperKEKB commissioning — •Hendrik Windel for the CALICE-D-Collaboration — Max-Planck-Institut for Physics

The CALICE collaboration is studying plastic scintillators coupled to silicon photomultipliers as sensors for calorimeters for future linear colliders like ILC and CLIC. Current detector concepts foresee up to ten million channels for the hadronic calorimeter. A larger number of different types of SiPMs and scintillator materials exist and their properties have to be investigated to provide best results. For these purposes a dedicated laboratory setup has been developed to provide high resolution scanning of the scintillator tiles with a radioactive source. The data acquisition of this setup as well as a fast online analysis has been implemented in LABVIEW. A modified version of this setup, together with hardware previously used for measuring timing properties of hardronic showers, will be used in the commissioning phase of the SuperKEKB accelerator. This contribution will discuss results from detailed investigations of different scintillator tiles, including the study of different materials. Key performance criteria for their application in calorimetry and in background measurements with high time resolution at SuperKEKB will also be presented.

T 94.5 Do 17:45 VMP6 HS E

Dark noise rates in irradiated silicon photomultiplier arrays — Sebastian Bachmann, Albert Comerma, •David Gerick, Xiaoxue Han, Stephanie Hansmann-Menzemer, Matthieu Kecke, Blake Leverington, José Mazorra de Cos, Dominik Mitzel, Max Neuner, and Ulrich Uwer for the LHCb-Collaboration — Physikalisches Institut, Universität Heidelberg

The planned downstream tracking system - the Scintillating Fibre Tracker - for the LHCb upgrade uses silicon photomultiplier (SiPM) arrays of 128 channels to read out mats made of 250 μm diameter scintillating fibres. In the LHCb environment the neutron flux degrades the silicon detectors to the edge of an acceptable performance in terms of DCR. Studies have shown that the dark count rate (DCR) of the SiPMs increases linearly with the neutron flux. Towards the end of the designed lifetime of the experiment the DCR per SiPM channel operated at $T = -40°C$ is expected to reach a few MHz after partial annealing.
To reduce the impact of the DCR - while at the same time provide efficient hit reconstruction - a clustering algorithm is developed to separate signal from noise. A brief introduction into the custom designed read-out ASIC and the cluster algorithm will be presented along with the studies of the dark count cluster rate dependency on the neutron flux, the DCR per channel and the effects of the applied signal thresholds for the clustering algorithm.

T 94.6 Do 18:00 VMP6 HS E

Study of the radiation damage of silicon photomultipliers — •Michael Nitschke, Valery Chmill, Erika Garutti, Robert Klanner, and Jörn Schwandt — Institute for Experimental Physics, Hamburg University, Luruper Chaussee 149, D-22761 Hamburg, Germany

Radiation damage significantly changes the performance of silicon photomultipliers (SiPM). In this work, we first have characterized KETEK SiPMs with a pixel size of 15x15 μm^2 using I-V (current-voltage), C/G-V/f (capacitance/impedance-voltage/frequency) and Q-V (charge-voltage) measurements with and without illumination with blue light of 470 nm from an LED. The SiPM parameters determined are DCR (dark count rate), $relative\ PDE$ (photon detection efficiency), G (Gain), XT (cross-talk), Geiger breakdown characteristics, C_{pix} (pixel capacitance) and R_q (quenching resistance).
Following this first characterization, the SiPMs were irradiated using reactor neutrons with fluences of 10^9, 10^{10}, 10^{11}, $5 \cdot 10^{11}$, and 10^{12} n/cm^2. Afterwards, the same measurements were repeated, and the dependence of the SiPM parameters on neutron fluence was determined. The results are used to optimize the radiation tolerance of SiPMs.

T 94.7 Do 18:15 VMP6 HS E

Teststand zur elektrischen und optischen Charakterisierung von SiPMs — Thomas Hebbeker, •Carsten Heidemann und Markus Merschmeyer — RWTH Aachen, III. Physikalisches Institut A

Silizium-Photomultiplier (SiPMs) sind Lichtdetektoren, die sehr empfindlich für Photonen, aber leider auch für Änderungen der Umgebungsbedingungen sind. Die verschiedenen experimentellen Anwendungen stellen unterschiedliche Anforderungen an die SiPMs. Es wird ein Teststand vorgestellt, der zur Charakterisierung von SiPMs dient. Der Teststand bietet eine temperaturstabilisierte Umgebung für einen großen Temperaturbereich, um die verschiedenen Einsatzszenarien simulieren zu können. Eine spezielle Multifunktionslichtquelle liefert ein breites Spektrum von UV bis Rot mit einstellbarem Photonenfluss, sowohl kontinuierlich als auch gepulst. Mittels Monochromator lassen sich auch schmale Wellenlängenbreiche abgreifen. Der Teststand bestimmt u.a. die folgenden Eigenschaften vollautomatisch: Rauschraten (thermisch), Noise-Effekte (Crosstalk, Nachpulsen), absolute und relative Photondetektionseffizienz (PDE), Erholungszeit. Der Teststand ermöglicht die Charakterisierung von SiPMs im 4D Parameterraum von Temperatur, Betriebsspannung, Lichtwellenlänge und Lichtintensität.