Contribution submission to the conference SMuK 2023

Evaluation of the Performance of SiPM-on-Tiles at the End of Life of the CMS HGCAL Upgrade — •Malinda de SIlva, Katja Krüger, Mathias Reinecke, Ole Bach, and Felix Sefkow — Deutsches Elektronen-Synchrotron (DESY), Hamburg

For the HL-LHC phase, the calorimeter endcap of the CMS detector will be upgraded with a High Granularity Calorimeter (HGCAL), a sampling calorimeter that will use silicon sensors as well as scintillator tiles read out by silicon photomultipliers (SiPMs) as active material (SiPM-on-tile). The design of the SiPM-on-tile section was inspired by the CALICE AHCAL. The complete HGCAL will be operated at $-30°C$.

The basic detector unit in the SiPM-on-tile section is the tile module, consisting of a PCB with one or two HGCROC ASICs, reading out up to 96 SiPM-on-tiles. Signals from MIPs passing through the SiPM-on-tiles are used to quantify the performance of SiPM-on-tiles. With irradiation, their performance degrades while increasing the noise. The ratio between the MIP signal and noise is known as the signal-to-noise ratio (SNR). In order to maintain an SNR$>$3 at end of the detector lifetime, SiPMs will be used in areas where the expected radiation dose during the lifetime of the detector is less than $5 \times 10^{13} n_{eq}/cm^2$.

A series of tests were conducted to quantify the performance of SiPM-on-tiles mounted on tile modules including beam tests and cold tests at $-30°C$. These tests were also repeated using irradiated SiPMs mounted on the tile modules. These tests were then used to extrapolate the performance expectations at the detector's end of life.

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Type: Vortrag;Talk
Topic: 3.05 Kalorimeter; 3.05 Calorimeters
Email: malinda.de.silva@desy.de