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SiPM Experience from more than Six Years Operation of FACT

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The First G-APD Cherenkov Telescope (FACT) is pioneering the usage of SiPM in Imaging Atmospheric Cherenkov Telescopes. Its camera consists of 1440 SiPM, each coupled to a solid light-guide and an individual read out. In October 2011, the camera was installed in a refurbished telescope structure with a mirror area of 9.5m^2 at the Canary island La Palma, and successful data taking started within few hours. Since then, FACT is taking data whenever observation conditions permit, with the primary goals of gaining long-term experience with operation of SiPM under harsh conditions as well as monitoring a set of variable extragalactic high energy gamma-ray sources.

For the science goal, stable performance of the photo detectors is crucial and therefore has been studied in great detail. Special care has been taken with regards to keep the gain of the SiPM constant despite their temperature varying by more than 25 deg. This is reached through implementation of a feedback system that regularly adjusts the applied voltage to the sensor temperature as well as to the current drawn due to varying night-sky brightness.

Several independent long term measurements were conducted to analyze and verify SiPM stability. As example, dark count spectra, which also make for an excellent self calibration mechanism, were used to study and model the temperature dependencies. Trigger thresholds are adjusted to the night-sky background by measuring the current drawn by individual groups of pixels.

With these methods, the performance of the FACT camera is kept stable without the need for any external calibration device. While each of the 1440 SiPM has collected a charge of more than $???\text{C}$ so far, there is no indication of any ageing or any other sensor-related problems. The exceptional reliability of the system allows to operate FACT as the only Cherenkov telescope so far in a fully robotic way.

In this talk, the results of the long term performance studies and experience gained from the six years operation of SiPM will be presented.

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