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Studies of SiPM Behavior under Continuous Light Illumination

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This work reports on the behavior of the Silicon Photomultiplier (SiPM) detector under continuous light illumination. Large area $\sim 1 \text{ cm}^2$ hexagonal SiPM S10943-2832(X) produced by Hamamatsu HPK for the single mirror small size telescope SST-1M (one of the projects proposed for the implementation of the small size telescopes of the Cherenkov Telescope Array CTA) has been used for studies. The bias circuit of the SiPM contains a resistor meant to prevent the sensor from drawing high current and cut high frequency electronic noise. However, this resistor together with SiPM quenching resistor introduce a voltage drop during light detection at the SiPM input, impacting the stability of its operation. Electrical (i.e. breakdown voltage, gain, pulse amplitude), noise (dark count rate and optical crosstalk) and optical (i.e. photon detection efficiency) parameters were studied under five different light illumination levels from 3 MHz up to 1 GHz of photons per SiPM micro-cell at room temperature ($T = 25 \text{ }^\circ\text{C}$). The experimental results were compared with toy Monte Carlo simulation. From our studies, a model have been developed in order derive the parameters needed to account for it at the data analysis level. Also, a solution is proposed to compensate for the voltage drop and will be presented.

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