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SiPM Characterization at GAE-UCM in collaboration with CTAO

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Silicon photomultipliers (SiPMs) are increasingly becoming the standard in cutting-edge photodetection applications, offering significant advantages over classical photomultiplier tubes (PMTs) such as lower cost, insensitivity to magnetic fields, and fast temporal response. In the field of high-energy astrophysics, these properties are critical for the next generation of Ground-Based Gamma-ray Astronomy, where SiPM-based cameras promise higher granularity and improved sensitivity for Cherenkov telescopes.

The GAE-UCM group maintains two parallel research lines: the high-precision characterization of Silicon Photomultipliers (SiPMs) and active involvement in the Cherenkov Telescope Array Observatory (CTAO), which will become the world's most sensitive Cherenkov observatory. In this oral contribution, we will present our characterization capabilities, latest modeling results, and the strategic role our group has played in evaluating SiPMs for CTAO.

To properly study SiPM characterization, we have developed a comprehensive set-up consisting of an integrating sphere, different light pulses, scintillators, and dedicated readout PCBs. This enables us the measure of key SiPM parameters such as Photon Detection Efficiency (PDE), gain via finger plots, and correlated noise. Furthermore, we have developed software resources for a more complete analysis, such as dedicated correlated noise analysis software and a detailed Monte Carlo code. In addition, we will summarize our latest modelling result: a non-linear model based on microcell recovery.

Finally, we will report on the study of SiPM candidates for the final version of the new CTAO cameras. This analysis encompasses various critical parameters, including correlated noise, pulse shape characteristics, and the evaluation of specialized resin layers designed for red-photon absorption.

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