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PROPOSAL FOR A SIPM-BASED COSMIC RAY DETECTOR FOR USE ON SUBORBITAL AND ORBITAL FLIGHTS

Abstract

We present a compact, lightweight, low power consumption, robust cosmic ray detector based on Si photomultipliers (SiPM) and plastic scintillator, optimized for use as a payload in standard cubesat systems for suborbital or orbital flights.

Astroparticle detection from space has traditionally involved the use of photomultiplier tubes (PMT), but there is increased interest in moving towards solid state SiPM, whose technology is maturing towards an equivalent photo-detection efficiency to that of PMTs, but with less weight, mechanical robustness, lesser cost and the practical advantage of not requiring high voltage. That said, problems still remain for its space utilization, mainly in the form of a dark current which rather strongly depends temperature, as well as a potential susceptibility to TID and SEE.

In fact, the original purpose of the particular detector we present here is to characterize the stability and performance of SiPM in suborbital and orbital conditions using low energy CR as a standard candle. As such, the detector is developed in a format compatible with cubesat mechanical standard and power consumption requirements. Despite this original focus, the detector can also be used for educational purposes and eventually, after proper calibration, for low energy trapped radiation omnidirectional measurements above a certain context dependent energy threshold.

The first prototype has been tested in a suborbital flight over Mexico on board the stratospheric platform ATON of the Laboratory of Space Instrumentation (LINX) of the Institute of Nuclear Sciences (ICN) in December 2017, as part of an operational in-flight test of the nanosat NanoConnect-1.

In the current work we present the detector mechanical and electronic structure, its operational philosophy, as well as the results of laboratory and stratospheric tests.