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Compact and Light All-in-One Detectors for space application

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The advent of the system on a chip that integrates a CPU unit and multiple input-output analogs and digital peripherals and the simultaneous improvement of Silicon photomultiplier detectors with a low dark count has allowed our group of INFN Rome1 to build in 2014 the first all-in-one scintillation detector in literature called ArduSiPM.

The original idea is to use the minimum possible COTS components external to the SoC (typically fast analog) and make the most of the peripherals inside the chip, thus obtaining compact electronics without using ASICs and an external data acquisition system.

The system consists of a scintillator, a SiPM, conditioning electronics, and a microcontroller with fast peripherals. The detector can measure the rate, the arrival time with an accuracy of tens of nanoseconds, and the number of photoelectrons produced in the SiPM.

Compared to the ASICs solution, having a processor and related communication interfaces onboard has allowed us to build an all-in-one detector, including a control system, data acquisition and elaboration, and relative data transmission using only COTS.

This approach has proved to be very fruitful as the importance of technology is not only given by its current state but its growth trend.

In the last few years, the class of microcontrollers has acquired performance in terms of the internal CPU's speed and the number and speed of peripherals.

As CSN5 INFN MICRO experiment, we explore different circuits and engineering solutions to use this class of detectors in various fields such as picosatellites, Transient Luminous Events in the high atmosphere, and analytical chemistry to measure the bioluminescence.

In the case of picosatellites, we plan to integrate our detector into the onboard computer firmware, making it one of the system's peripherals consisting of actuators, navigation instruments, and attitude control.

Collaboration

CSN5 INFN MICRO

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