INFN Camera Demonstrator for the Cherenkov Telescope Array

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ABSTRACT

The Cherenkov Telescope Array (CTA) is a world-wide project dedicated to ground-based gamma-ray astronomy. The experiment is planned to include two arrays of more than 100 telescopes which will detect gamma rays from few tens of GeV to more than 100 TeV. In the core energy region (1-10) TeV it will improve by at least one order of magnitude the sensitivity of the Very High Energy (VHE) telescopes currently in operation (e.g. H.E.S.S., MAGIC and VERITAS).

The *Istituto Nazionale di Fisica Nucleare (INFN)* is developing a SiPM based camera that could be used by the proposed CTA-SST telescopes. A realistic and complete demonstrator, including Front-End Electronics (FEE), mechanical design and data acquisition is foreseen by the end of 2015.

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THE DEMONSTRATOR

The demonstrator (Fig. 1) will consist of a SiPM based focal plane made of 6×6 mm² monolithic sensors produced by FBK http://www.fbk.eu.

The signals will be conditioned by a PCB housing the FEE and coupled to a trigger dedicated board.

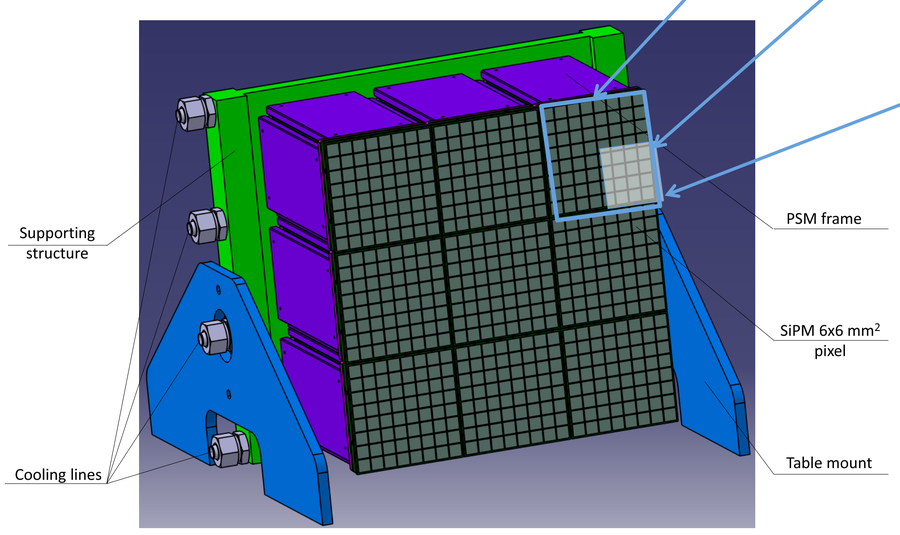

Fig. 1: Pictorial view of the INFN Camera Demonstrator.

THE MECHANICAL STRUCTURE

Due to the very compact design the main issue is the thermal dissipation: 15 W concentrated in an area of 16x16 cm² .

The adopted solution is to host the PCBs inside the PSM frame on the sides with heat dissipation by means of thermal pads, copper frames and water cooling system.

The mechanical structure is currently under construction and test at the Technological Laboratory of INFN in Turin, Italy (Fig. 3).

ACKNOWLEDGEMENTS

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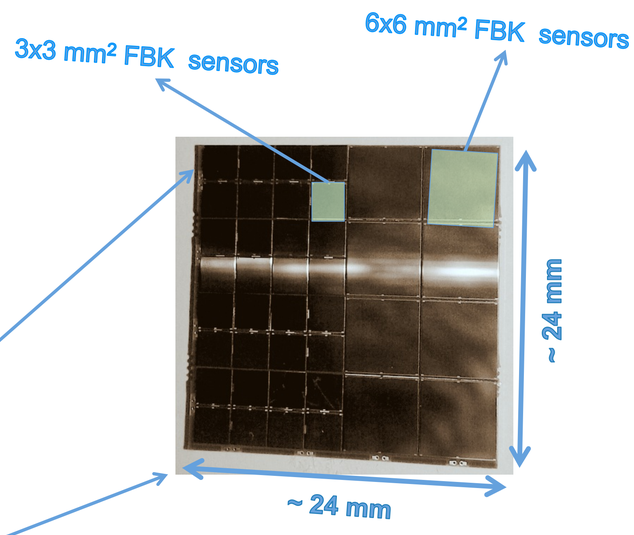

Fig. 2: ¼ of a PSM with two different pixel configurations.

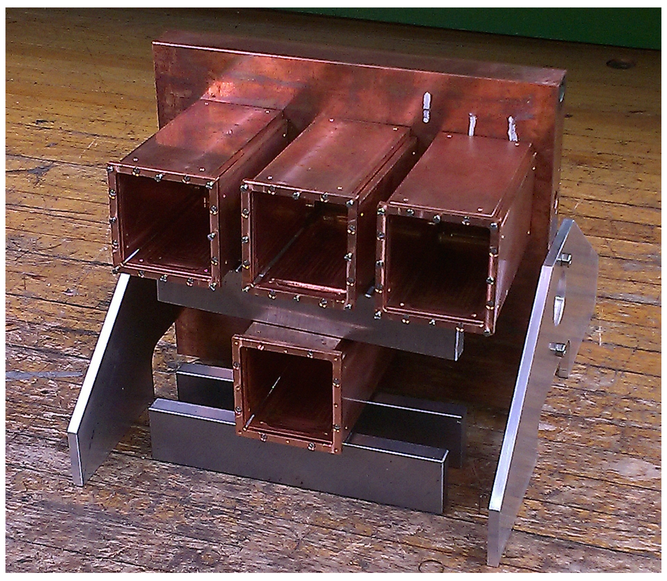

Fig. 3: The mechanical structure under construction at INFN Torino, Italy.

THE READOUT SYSTEM

The readout system has a modular approach (Fig. 4). Each board hosts the front-end pre-amplifiers and a Target 7 ASIC, responsible for:

- **sampling and digitization of the SiPM signals;**
- **local trigger (L0) .**

A backplane FPGA combines L0 triggers to generate a higher level trigger (L1).

FOCAL PLANE & SENSORS

A Photo Sensor Module (PSM) will consist of an array of 8×8 pixels, each one of 6×6 mm² area. Fig. 2 shows a picture of 1/4 of a PSM, with two different pixel configurations: 8 units of 6×6 mm² sensors on the right side, and 32 units of 3×3 mm² sensors on the left side, summed up in blocks of four to obtain the equivalent area of 6×6 mm² for each pixel.

This was done to verify and compare the performance of the two configurations based on different SiPM units.

The voltage to the SiPMs is biased by means of pads outside the active area and all SiPMs are bonded in daisy-chain.

This solution has been adopted to optimize the distance between adjacent pixels, obtaining a fill factor > 80%.

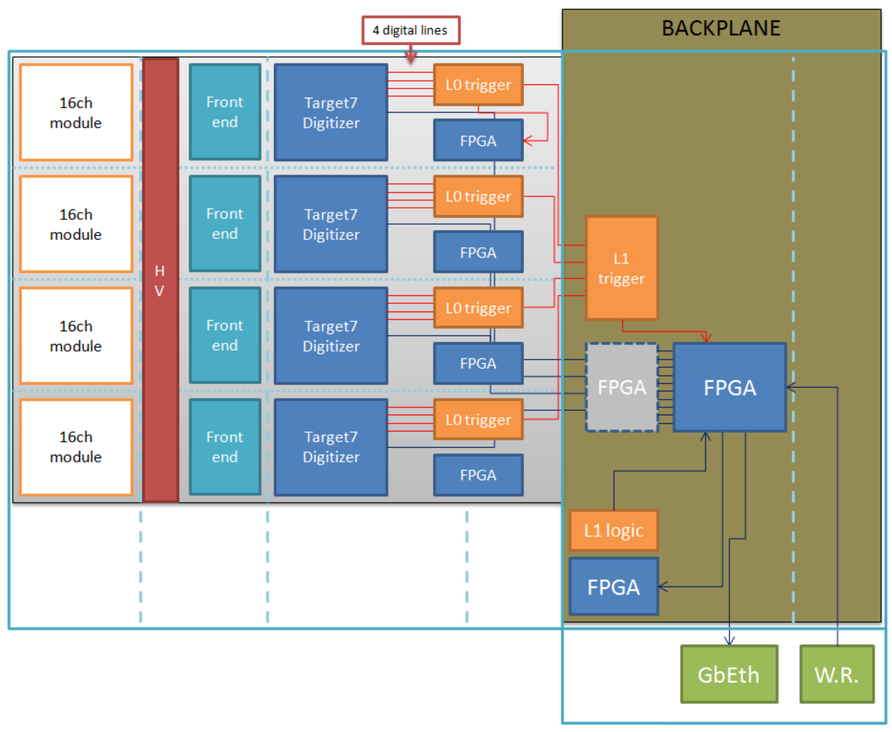

Fig. 4: Sketch of the readout system of one PSM.