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The Central Logic Board and its Auxiliary Boards for the Optical Module of the KM3NeT Detector

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The KM3NeT neutrino telescope will be composed of many optical modules, each of them containing 31 (3") photomultipliers, connected to a Central Logic Board. The Central Logic Board integrates Time to Digital Converters that measure Time Over Threshold of the photomultipliers signals while White Rabbit is used for the optical modules time synchronization. Auxiliary boards have also been designed and built in order to test and extend the performance of the Central Logic Board. The Central Logic Board, as well as the auxiliary boards, will be presented by focusing on the design consideration, prototyping issues and tests.

Summary

KM3NeT is a deep-sea research infrastructure, which will host a neutrino telescope with a volume of several cubic kilometres at the bottom of the Mediterranean Sea. It will be composed by thousands of Digital Optical Modules (DOMs), consisting of a glass sphere containing 31 (3") photomultipliers (PMTs) for the detection of the Cherenkov light induced by charged particles produced by the interaction of the neutrino with matter inside or in the vicinity of the KM3NeT detector. A group of 18 DOMs distributed over a 700 m mooring line constitutes a Detection Unit (DU) of the telescope.

The signal acquired by each PMT is sent to a Time Over Threshold (TOT) discriminator to fed the Time to Digital Converter (TDC) which is part of a Central Logic Board (CLB) based on a Kintex 7 Field Programmable Gate Array (FPGA).

The TDC resolution is 1 ns and the White Rabbit (WR) is used to guarantee time synchronization at the level of 1 ns between each DOM.

Additional peripheral devices are connected to the CLB, in order to keep track of both the environmental conditions (temperature, humidity), the DOM orientation (yaw, pitch, roll) and its position; some of them are embedded on the board, such as the temperature&humidity sensor and the tiltmeter&compass, while others are plugged to the CLB by using connectors, such as the acoustic devices (Piezo or Hydrophone) and the Nanobeacon (a LED device). Custom boards have also been designed and produced to test the performances of the CLB or to extend its functionalities.

All the incoming data are collected by the CLB and sent to shore using a dedicated optical network. Two Lattice LM32 microcontrollers are implemented in the CLB FPGA, one for the WR and the other for the instrumentation management.

Two batches of prototypes have been produced and are now operational in the laboratories of the KM3NeT Collaboration; 50 pieces were ordered to equip the first two KM3NeT DUs which will be deployed during 2015. A prototype detection unit has been deployed in May 2014 at the KM3NeT-It installation site 100 km SE of shore of Capo Passero, Sicily.

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