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The deep-sea Neutrino telescope KM3NeT - Timing and Readout

KM3NeT is large scale deep-sea neutrino telescope to be deployed and operated in the Mediterranean Sea. Neutrino induced muons are detected by measuring their Cherenkov light in sea-water using photomultiplier-tubes inside transparent and pressure resistant housings.
KM3NeT aims at instrumenting a large volume of several cubic-km with tens of thousands of optical sensors, each one interconnected with the shore through electro-optical cables with distances up to 100km.
The KM3NeT collaboration has successfully developed, as an optical sensor the Digital Optical Module (DOM), by placing multiple 31 3" photomultipliers (PMTs) in a 17" glass sphere including the power and readout electronics, providing the basic detection unit for the telescope. The DOM concept allows to maximize the photocathode area inside the sphere while the segmentation provided by individual PMTs allows better rejection of the ubiquitous K40 photon background in the sea.
To ensure a high level of flexibility with minimal bias in the observations, all data from each DOM is sent to shore for on-line analysis. While the shore receives from each DOM continuously digitized data, each DOM needs to be synchronized with a global shore clock at the nano-second level. To make best use of the resources for power and data transfer in KM3NeT we have adopted an integrated timing and readout scheme between each DOM and the shore station , by employing synchronous Gbit-Ethernet link, and precision-time protocol and clock phase tracking, in a transparent way, through the open source hardware implementation "White Rabbit".

Here we present the PMTs readout in a single DOM and the time synchronization scheme at the nano-second level for all DOMs in the deep-sea neutrino telescope KM3NeT.

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