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THE ANTARES NEUTRINO DETECTOR INSTRUMENTATION

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ANTARES is the First full operational and the largest neutrino telescope in the Northern hemisphere. Located in the Mediterranean Sea, it consists of a 3D array of 885 photomultiplier tubes (PMTs) arranged in 12 detection lines (25 storeys each), able to detect the Cherenkov light induced by upgoing relativistic muons produced in the interaction of high energy cosmic neutrinos with the detector surroundings (or volume). Among its physics goals, the search for neutrino astrophysical sources and the indirect detection of dark matter particles coming from the sun, are of particular interest. To reach that, a good accuracy in the muon tracks reconstruction is mandatory, so several calibration systems as timing and positioning systems have been developed.
In this talk we will present the design of the detector, calibration systems and associated equipment, along with a summary of the lessons learned for the future cubic kilometer detector in the Mediterranean sea, KMN3NeT.

Summary 500 words

ANTARES is the First full operational and the largest neutrino telescope in the Northern hemisphere. Located in the Mediterranean Sea, it consists of a 3D array of 885 photomultiplier tubes (PMTs) arranged in 12 detection lines (25 storeys each), able to detect the Cherenkov light induced by upgoing relativistic muons produced in the interaction of high energy cosmic neutrinos with the detector surroundings (or volume). Among its physics goals, the search for neutrino astrophysical sources and the indirect detection of dark matter particles coming from the sun, are of particular interest. To reach that, a good accuracy in the muon tracks reconstruction is mandatory, so several calibration systems as timing and positioning systems have been developed.

The ANTARES front-end electronics is based in the so-called Analogue Ring Samplers (ARS) chips, which are basically 2700 front-end ASICSs able to digitize the analogue PMTs signals, where a 25 ohms impedance in the motherboard converts the PMT current into a voltage. Analogue-digital conversion is done jointly by means of a threshold comparator, a charge integrator and a Pulse Shape Discriminator (PSD), which analyses the main
features of the signal, compares it to a predefined template and if a given condition is met, a full waveform of the signal is digitized. The time stamp (TS) of the hits is given by a counter incremented by a 20 MHz clock signal distributed from the shore to the whole aparatus. Such measurements are corrected by a set of offsets determined in-situ by a time calibration system based on a set of light sources installed in the detector, the so-called Optical Beacon System (OBS). The positioning system instrumentation consists of a set of transceivers located at the bottom of the lines which send acoustic signals to a set of 5 hydrophones located at specific heights on each line, plus a set of tiltmeters, compasses and sound velocimeters located at different depths.
The data acquisition system and the control electronics are housed in a Ti container in each detector storey known as
Local Control Module (LCM). Comunications to the shore station are performed with 5 Master local Control Modules (MLCM) per line which are equipped with an ethernet switch and a Dense Wave Division Multiplexing transceiver (DWDM). DWDM passive components as multiplexers and demultiplexers are located at the bottom
of each line into the so-called String Control Module (SCM), where the digitized data stream is finally sent to shore.

In this talk we will present the design of the detector, calibration systems and associated equipment, along with a summary of the lessons learned for the future cubic kilometer detector in the Mediterranean sea, KMN3NeT.

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