



Internship KM3NeT

KM3NeT Digital Optical Module cleaning device for deep sea use

4 to 6 Months

KM3NeT is a next-generation neutrino telescope currently being deployed on the bottom of the Mediterranean Sea, on two sites: ORCA near Toulon (France) at 2500m below the sea level, and ARCA near Capo Passero (Sicily) at 3500m into the abyss. While ORCA (Oscillation Research with Cosmics in the Abyss) is primarily dedicated to fundamental neutrino physics studies at GeV energies, ARCA's (Astrophysics Research with Cosmics in the Abyss) main goal is high-energy (TeV-PeV) neutrino astronomy [1].

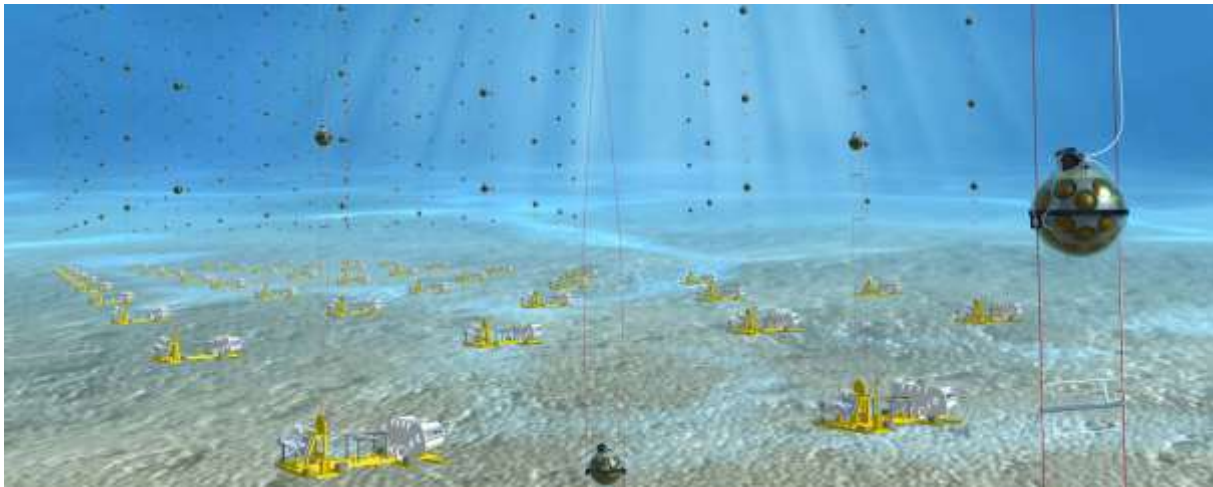


Figure 1 Artist representation of KM3NeT detector

On both sites, the detector is basically composed of a 3D array of thousands of so called Digital Optical Modules (DOM) able to detect the faintest Cherenkov light produced in the water by the muons resulted from the interaction of the neutrinos with the surrounding environment. Each DOM contains 31 photomultipliers (PMT) and different electronic boards encapsulated in a 40cm diameter borosilicate sphere [2].

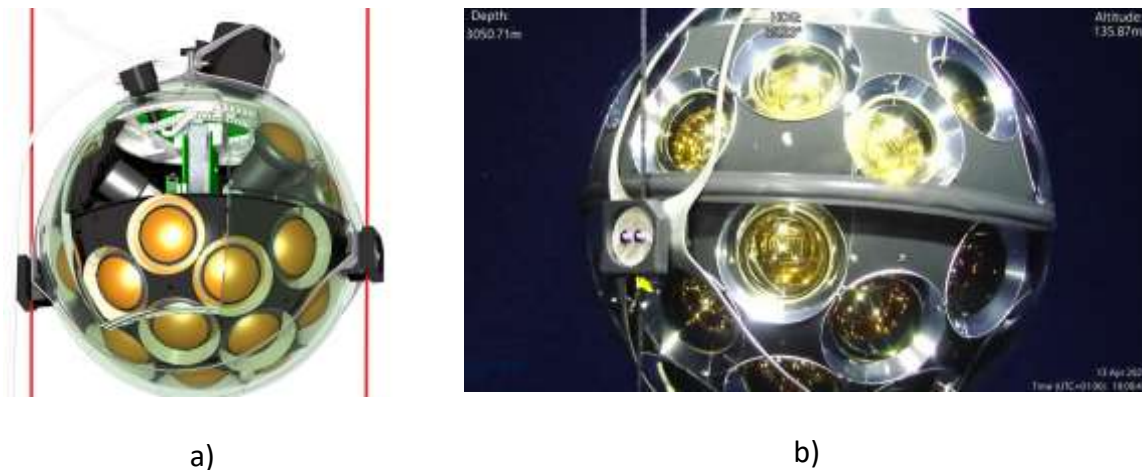


Figure 2 a) CAD model of a KM3NeT Digital Optical Module (DOM) b) Digital optical module immersed at 3200m into the abyss of the Mediterranean Sea



Once completed, the detector will have a lifetime of more than 15 years. During this period biofouling could accumulate on the upper side of the DOMs and perturbate the efficiency of the PMTs.

The main objective of this internship is focussed on the development of a passive cleaning device that could be integrated into the current design of the DOMs and adapted to the deployment procedure of a KM3NeT Detection Unit [3]. In a first step, the student will get familiarised with the CAD model of a digital module and it is expected the definition of a technical requirements specifications document. Secondly, he/she could propose different designs that will be discussed and analysed together with the APC mechanical engineers. The most suitable design will be manufactured in the workshop of the laboratory and will be integrated on a DOM already available. Further functional and acceptance tests could also be envisaged.

Useful skills and tools:

- Basic mechanical engineering knowledge
- Creativity and mechanical design skills
- Mechanical Drawings and manufacturing process
- 3D Experience, CATIA V5
- Marine environment engineering
- Understand English documentation

The AstroParticle and Cosmology laboratory (APC) is a Joint Research Unit (UMR) created in 2005. APC gathers about 75 permanent researchers, and about fifty engineers, technicians and administrative staff. The laboratory is centered around four main themes: Cosmology, Gravitation, High Energy astrophysics and Particles (KM3NeT Project). The inter will integrate the mechanical technical service of the laboratory for a period of 4 to 6 months (To be defined).

[1] S. Adrian-Martinez, et al. "Letter of intent for KM3NeT 2.0." *Journal of Physics G: Nuclear and Particle Physics* 43.8 (2016): 084001.

[2] S. Aiello et al. (KM3NeT Collaboration), *The KM3Net multi-PMT optical module*, JINST 17 (2022), P07038

[3] S. Aiello et al. (KM3NeT Collaboration), *Deep-sea deployment of the KM3NeT neutrino telescope detection units by self-unrolling*, JINST 15 (2020) P11027