Introduction

High energy cosmic neutrino astronomy is one of the most interesting frontiers of astrophysical research today. The observation of cosmic rays with energy has shown the existence of cosmic objects able to accelerate protons to extreme energies. Many celestial bodies, today observable only through their electromagnetic emission, could accelerate particles at very high energies.

Neutrinos appear as the preferential astronomic "probe" for very high astrophysical phenomena observation. They do not interact with the radiation and have only weak interactions with matter. Neutrinos, therefore, can carry information originating in very remote space sources, at a time near to the Big Bang, or in regions next to black holes where radiation density and matter does not allow the photons to escape.

The apparatus which one intends to build to observe (for a better observation) of the high energy cosmic neutrinos are, therefore, neutrino telescopes. On the basis of "conservative" hypothesis on the expected neutrino flux, it has been shown that to be able to statistically record a meaningful collection of events, in times of the order of one year, the telescope must have a detection area of approximately 1 km^2. Cosmic neutrino detection involves, therefore, the use of an interaction target of enormous dimensions.

The technique for the realization of the simpler and effective astrophysical neutrinos telescope is the instrumentation of great natural targets (such as the sea, the lakes or the polar ice) with optical sensors. The interaction medium is therefore used also as a radiator of the Cherenkov light radiated by the interaction products of neutrinos. The technique consists in tracking the charged leptons originating in the charged current weak interactions of the neutrino with a nucleus of the target to allow, subsequently, the direction reconstruction of the same neutrino.

The capabilities of these experiments are strictly dependent on how well time measurements are performed in the detectors. In fact, the reconstruction of the physical events, extracted from the large environmental background typical of the marine abysses, is based on the possibility to properly align in time the measurements performed by a large number of widely spaced sensors. In all cases in which the signals are digitized and time-stamped offshore, two different tasks are required for aligning in time the measurements: synchronization of the electronics, i.e. the delivery of common clock signals to the whole apparatus, and timing calibration of the sensors, i.e. how the local time measurements performed by the individual sensors compare to the time measured onshore. Here, we illustrate the timing calibration system of the NEMO (NEutrino Mediterranean Observatory) project, focusing on project, implementations and tests of the prototype apparatus of NEMO Phase 1.

The chapter 1 describes few hints of neutrino astronomy, the motivations for neutrino telescopes, revelation principles and a summary view on the project NEMO. The chapter 2 will be dedicated to presentation of the subsystems involved in the prototype NEMO phase 1 mini-tower. In the chapter 3 there are the descriptions of the concepts of offsets calculation, the adopted tools, the devices used, the implemented software and some results obtained during the research. The fourth chapter is dedicated to the analysis of the calibration data and the description of the tools and solutions chosen, also some results have been presented and several validation tests performed. In the fifth chapter are presented few hints on the ongoing work preformed for the new version of timing calibration system to integrate on the full tower of NEMO phase 2 that will be deployed at the end of this year.