The cubic-kilometer neutrino telescope (KM3NeT) forms a large-scale neutrino research facility, consisting of two water Cherenkov detectors, which are currently under construction on the Mediterranean seabed. The first detector, called ARCA (for Astroparticle Research with Cosmics in the Abyss), is situated at a depth of 3500 meters, approximately 100 kilometres off-shore from the Sicilian town of Poropalo di Capo Passero. Its main research goal is to locate sources of high-energy cosmic neutrinos on the sky. The second detector, called ORCA (for Oscillations Research with Cosmics in the Abyss), is situated at a depth of approximately 2450 meters, about 40 km off-shore from the French city of Toulon. This detector's main aim is to determine the mass ordering of neutrinos.

Both detectors use a similar hardware infrastructure, consisting of building blocks which comprise 115 strings, each containing 18 optical modules. The optical modules are instrumented with 31 Hamamatsu R12199-02 3-inch PMTs, which can detect single Cherenkov photons emitted during neutrino interactions in the seawater. By placing the optical modules at specific distances relative to each other, neutrino interactions at different energies can be observed. The sparser ARCA detector, with an average horizontal spacing of 90 meters and average vertical spacing of 36 meters, targets neutrinos with an energy above 1 TeV. On the other hand, a 20 meters horizontal and 9 meters vertical spacing, grants the ORCA detector sensitivity to neutrinos with an energy between 1 GeV and 1 TeV. This includes the domain between 1 GeV and 10 GeV, where depending upon the distance traveled through the Earth and upon the mass ordering of the neutrinos, oscillation probabilities are resonantly enhanced due to the MSW effect.

A challenge in reaching the science goals of both KM3NeT-ORCA and KM3NeT-ARCA, is the background rate from radioactive decays in the seawater and from bioluminescence which fluctuates around 7 kHz. A high data compression rate is needed in order to keep this background below the maximal throughput of 200 Mbps per optical module set by the fibre-optics bandwidth, whilst keeping the fraction of data which can be sent to shore for neutrino event triggering as high as possible. This is achieved by reducing the full waveforms associated with each PMT hit to datapackets of 6 Bytes. A single Byte is used to store the address of the hit PMT, four Bytes are used to store the arrival time of the hit and another Byte is used to store the duration of time during which the analogue pulse corresponding to the PMT hit exceeded the threshold set by the hardware discriminator. The latter quantity is referred to as the time-over-threshold (ToT).

The experimental sensitivities that can be reached by KM3NeT-ORCA and KM3NeT-ARCA are determined in large part by the accuracy of the calibration procedures. One parameter that needs to be calibrated for each PMT is the gain, which can be defined as the average current amplification of the PMT signal between the photocathode and the anode. This is done based on the time-over-threshold. An analytical pulse shape model has been developed which allows for the conversion between the integrated charge of a PMT pulse and the corresponding time-over-threshold. This model consists of a Gaussian with an exponential tail, stitched together where the respective function values and derivatives match. The result is a logarthmic dependence between the charge and the time-over-threshold. A linear domain is added to account for PMT analogue pulses with an amplitude in excess of the voltage bias set over the hardware discriminator, causing the top part to be clipped. In addition, an inverse square-root modulation is applied to account for saturation of the electron multiplication process.

The established relationship between the charge and time-over-threshold can be exploited to relate the single photo-electron charge distribution, used to determine the gain of a PMT, to the equivalent single photo-electron time-over-threshold distribution, measured for Potassium-40 decays in the seawater. This allows for the determination of the PMT gains in terms of the time-over-threshold. Moreover, the relationship can be used to tune the gains to a nominal current amplification of $3 \cdot 10^6$. To achieve this, the PMT gains need to be fitted to single time-over-threshold distributions measured at different applied high-voltage settings. Subsequently, an optimal high-voltage setting can be interpolated, making use of the fact that the PMT gain and high-voltage are related approximately according to a power-law. Recent high-voltage tunings have shown that the PMT gains can be equalized to within approximately 2% of the nominal level.