Results from the
NEMO-Phase2 Tower in Capo Passero Site

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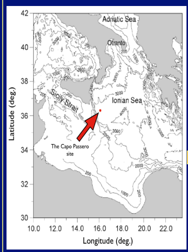
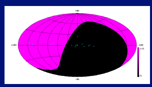
The NEMO-Phase2 Tower

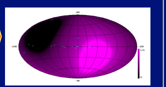
In March 2013, the NEMO-Phase 2 Tower, a prototype of the KM3NeT-It Towers, has been successfully installed in the Capo Passero site, at a depth of 3500 m and 80 km off from the southern coast of Sicily.
The unfurled tower is 450 m high; it is composed of 8 mechanical floors, for a total amount of 32 PMTs and various instruments for environmental measurements. The tower positioning is achieved by an acoustic system. The tower acquires and transmits all the measured signals to shore, to the INFN Laboratory in Portopalo, Sicily. Data reduction is completely performed in the on-shore laboratory by a dedicated computing facility connected to a persistent storage system at INFN-LNS, in Catania. The analysis of data collected during 12 months shows that the PMT single rates are stable and are compatible with what is expected by the Cherenkov light due to particles from radioactive ^{40}K decay, with a small percentage of light bursts due to bioluminescence. These features confirm the optimal nature of the Capo Passero abyssal site (KM3NeT-It) to host the KM3NeT Phase 1 detector (8 Towers + 24 KM3NeT Strings) and its possible future extensions".



Capo Passero, Sicily, Italy: the KM3NeT-Italy site

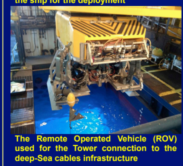


IceCube Sky view from the South Pole



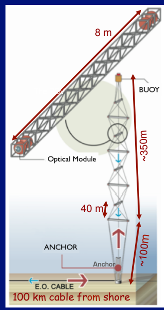
KM3NeT-Italy site Sky view from 36° North

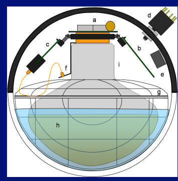
The Tower ready to be transported on the ship for the deployment



The Remote Operated Vehicle (ROV) used for the Tower connection to the deep-Sea cables infrastructure

A schematic view of the NEMO-Phase2 Tower in data acquisition, at 3500m depth, since March 23rd, 2013

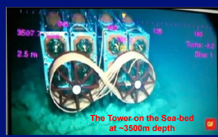




a. voltage divider circuit;
b. Front – End Module (FEM);
c. fast optical pulser;
d. feed trough connector;
e. pressure-gauge;
f. optical fibre;
g. mu-metal cage;
h. optical gel;
i. PMT 10" Hamamatsu R7081 sel

From Capo Passero site the KM3NeT-IT Cherenkov Neutrino Telescope will be able to search for neutrinos from the Galactic Centre, and will complement the view of the sky from Antarctica.

The Tower during the deployment



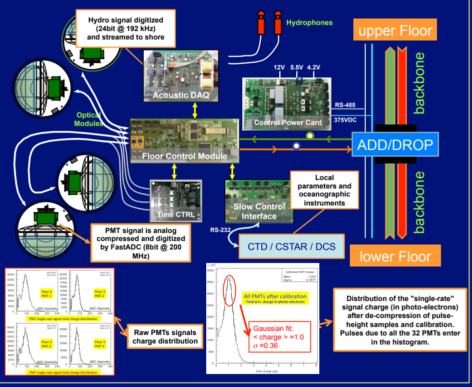
The Tower on the Sea-bed at ~3500m depth

The Tower main features: sensors, calibration tools, electronics, environmental condition probes

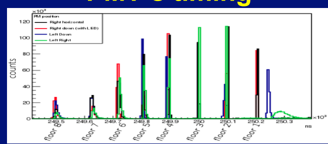
Tower and floors

- Main floor characteristics:
  - Backbone with fibre and power
  - 1 central vessel electronics
  - 4 Optical Modules
  - 2 Hydrophones
- Calibration sensors:
  - Laser beacon
  - LED-beacon, TIM-CAL
- Oceanographic Sensors:
  - Conductivity/Temperature/Depth
  - Transmissivity
  - Current speed meter

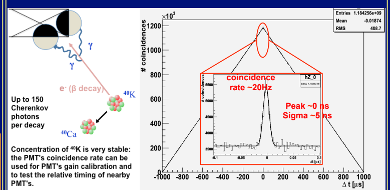
Off-shore data Acquisition electronics components



PMT`s timing



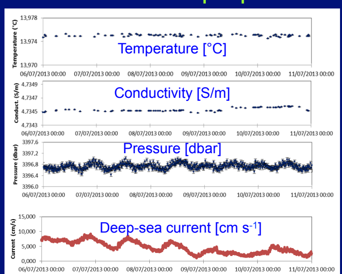
The arrival time of the light flashed by the nano-beacon of OM 1 of floor 1 on the OMs on all the floors (OM 1 of floor 1 included). The apparent dispersion among the measures of floor 1 OMs is due to their disfavored acceptance with respect to the emitting beacon on OM1 of the same floor.



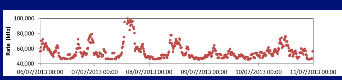
Adjacent PMTs coincidences, due to photons originated by a ^{40}K decay, in "minimum bias trigger" 1 ms wide

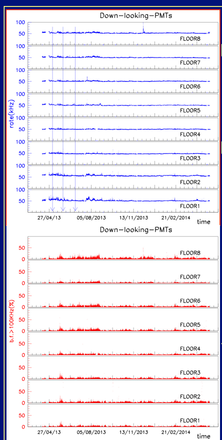
Tower prototype in KM3NeT-It site: 1 year of continuous data-taking

Environmental properties

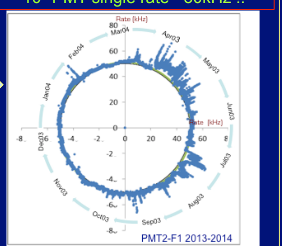


and PMTs rates





One year measurement of PMTs single rate [kHz], averaged over 15 min: 10" PMT single rate ~50kHz !!



Black line indicates 50kHz.
Green line is normalized to July first week baseline

Burst Fraction measured along one year: i.e. % of time with PMT rate > 100kHz, typically < 1-2%: **very low optical noise from bioluminescence !!!**

Atm. μ tracks reconstruction