# NESTOR Neutrino Telescope Status Report

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## Abstract

The first so-called floor with 12 detector modules of the NESTOR deep sea high energy muon and neutrino telescope had been deployed successfully this March (2003) together with its electronics system. Since that data the system and the associated environmental monitoring units are operating properly and data

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**Fig. 1.** Nestor detector floor showing the two detector modules at the end of each of the six support arms, the central electronics housing and modules.

are being recorded. We outline very briefly the NESTOR project, the deployment of the first floor, its current operation and the project status. The first data are presented and the plans for the next steps summarized.

## 1. Introduction

The NESTOR high energy muon and neutrino telescope, now under construction at the NESTOR Institute, located in Pylos, in the southwest of the Peloponnese (Greece), will be installed approximately 20 km off-shore at a depth of 4000 m, west of Pylos. The telescope will record the Cherenkov light of high energy muons of cosmic ray and neutrino induced origin. A basic telescope tower consists of 12 so-called detector floors, arranged one above the other with a vertical separation of 30 m. Fig. 1. shows a typical 32 m diameter detector floor unit with two optical detector modules mounted at the end of each of the six arms of the support structure, one above the other, and the one meter diameter titanium sphere that houses the floor electronics.

The detector modules consist of 15 inch photomultiplier tubes (PMTs) mounted inside 17 inch glass pressure housings. The PMTs in the upper modules face upward, the ones in the lower downward. Combined the two modules yields a very uniform $4\pi$sr optical sensitivity. Detailed descriptions of the system and site properties are published elsewhere [1, 2].

## 2. Deployment of First Detector Floor

In March 2003 the first detector floor of a NESTOR tower had been successfully deployed at the NESTOR deep-sea site in the Ionian sea at a depth of 4000 m. The floor unit is connected to the shore station and counting room in Methoni, located about 10 km south of Pylos, by a 28 km long 12-fiber electro-optical cable which powers the system and handles the data and command links between the submerged system and the shore. The shore cable is terminated at the deep-sea site in a junction box which is an integral part of the so-called anchor pyramid that serves among other purposes to anchor the neutrino telescope on the sea floor. It also houses a number of environmental monitoring instruments that are linked to shore for continuously surveying the site, and the sea water power return. The cable from the central electronics box of each detector floor is then connected to the junction box.

Up to date all deployment operations were made from a service ship and consisted of the following steps: a) locate the cable terminal on the sea floor, b) heave the anchor pyramid with the junction box on board of the service ship, c) connect the cable from the titanium electronics box of the detector floor unit to the junction box and d) re-deploy the anchor pyramid with the detector floor. Thus, all cable connections were made outside the water, on board the ship. This procedure does not require any robot or special submarine, it is cheap, quick, efficient and without problems. For the present deployment the detector floor was mounted some 150 m above the anchor.

The NESTOR site is a large deep-sea plateau off the south-western tip of the Peloponnese, only 11 nautical miles ( 20 km) from the port of Methoni where the shore station is located. Far from the effluents of major rivers, it benefits from extremely clear water and weak sea currents.

## 3. Initial Operation and First Data

The junction box and control electronics were powered from the shore station during deployment and all monitoring units were operational. The PMTs were powered several hours after deployment, allowing them to reach a sufficiently quiescent state following the brief exposure to daylight during the initial phase of the deployment, before being taken into service.

The present detector floor structure measures only 12 m in diameter but consists of the usual 6 module support arms and is equipped with a total of 12 of our standard 17 inch optical modules (non in the center) arranged in the same manner as outlined above and shown in Fig. 1. of the 32 m diameter floor.

The purpose of this deployment is not only an engineering run but to carry out an overall system performance test under real conditions at full depth with the unavoidable 40K and bioluminescence backgrounds, to study the characteristics of the modules, to test the control and data acquisition system, the software, including its event reconstruction capability, and to acquire experience with the overall system operation. Extensive environmental studies had been made in the past and all relevant environmental parameters had been established [2].

Timing and coincidence studies were carried out as well as muon trajectories reconstructed, focusing chiefly on very inclined, near horizontal muons. Overall system timing distributions were measured with the LED calibration flashers

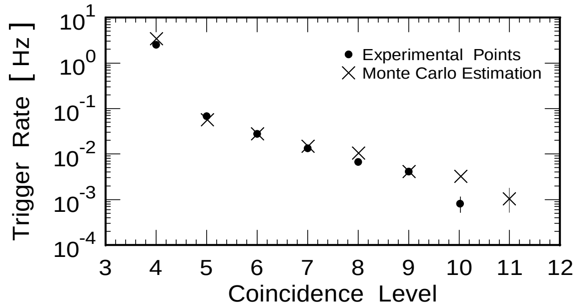


**Fig. 2.** Trigger rates of $\geq$ 4-fold coincidences measured at a depth of 4000 m at the 0.25 p.e. detector threshold level and simulated event rates.

**Table 1.** Measured and Predicted $\geq$ 4-Fold Coincidence Rates at 4000 m Depth.

| | $\geq$ 4 Fold Coincidence Rates | |
|---|---|---|
| | Thresholds set to 0.25 p.e. | Thresholds set to 1 p.e. |
| Measured | $2.61 \pm 0.02$ Hz | $0.12 \pm 0.01$ Hz |
| M.C., Muons only | $0.141 \pm 0.005$ Hz | $0.12 \pm 0.01$ Hz |

located 20 m above and 20 m below the center of the floor plane of symmetry, comparing the relative timings between any two detector modules on neighboring support arms facing either both up or both down. In all cases the full width at half maximum was $\leq$ 8 ns. The coincidence window was set to 62 ns. In Fig. 2. we show the Monte Carlo estimated and actually measured trigger rates for $\geq$ 4-fold coincidence rates at the 0.25 photoelectron (p.e.) level. The total trigger rates for $\geq$ 4-fold coincidences and thresholds of 0.25 and 1.0 p.e. are given in Table 1.

## 4. Conclusions

The NESTOR project is well under way and the deployment of several fully equipped 32 m diameter floor units is planned for the near future.

## 5. References

1. Grieder, P.K.F., et al. 2001, Nucl. Phys. B (Proc. Suppl.) 97, 105
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