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First Test of CRONOS, the NESTOR SLOW CONTROLS System

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Abstract

A prototype of the NESTOR[1,2] Slow Controls System, CRONOS (Controls for Realtime Observations of Nestor and Oceanographic Studies) was assembled and tested in the Titanium sphere of two floors. The system was used to measure the temperature distribution inside the closed spheres.

1 – INTRODUCTION

During the autumn of 1996 the NESTOR collaboration assembled in the Pylos laboratory two complete floors of the NESTOR tower.

The original plan was to deploy the two floors to 3800 m depth, hanging from a support ship and connected with it via a fiber optic cable implementing a serial asynchronous connection.

The deployment was impossible due to whether conditions, but the two titanium spheres were assembled and tested, together with the optical link, in the laboratory. Power was supplied to the spheres by a 300 VDC system through a conductor contained in the optical cable. The power return was through plates hanging in a tank of sea water.

Fig. 1 shows the power distribution scheme.

Fig. 2 shows the arrangement of the first sphere.

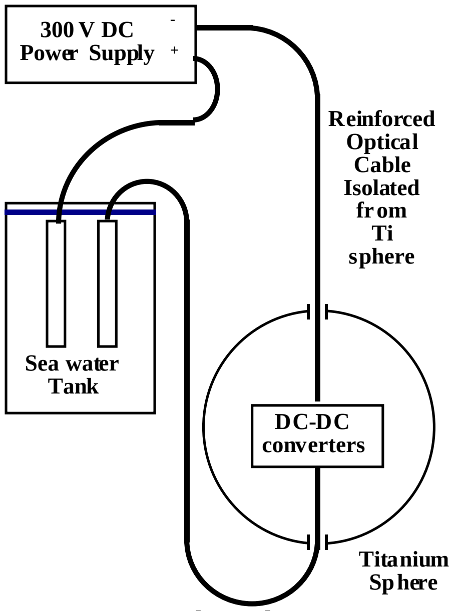

Fig. 1– Power supply and sea water return scheme.

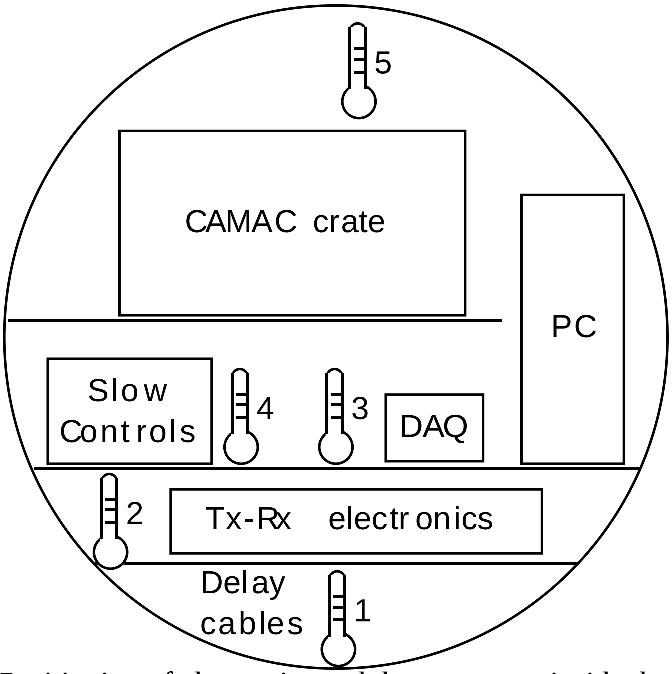

Fig. 2 – Positioning of electronics and thermometers inside the first Ti sphere.

2 – THE SLOW CONTROLS

Both spheres contained a prototype of the Slow Control system.

A serial port on the microcontroller was used for readout of the data and input of the commands . The data were read out through 4.5 Km of optical fiber. Two PCs controlled the transmission on the fiber, allocating space for the three data flows from the DAQ electronics, the CAMAC electronics and the Slow Controls (see Fig. 3). Two computers on the surface side performed the data acquisition and display for the DAQ electronicd and the Slow Controls, respectively.

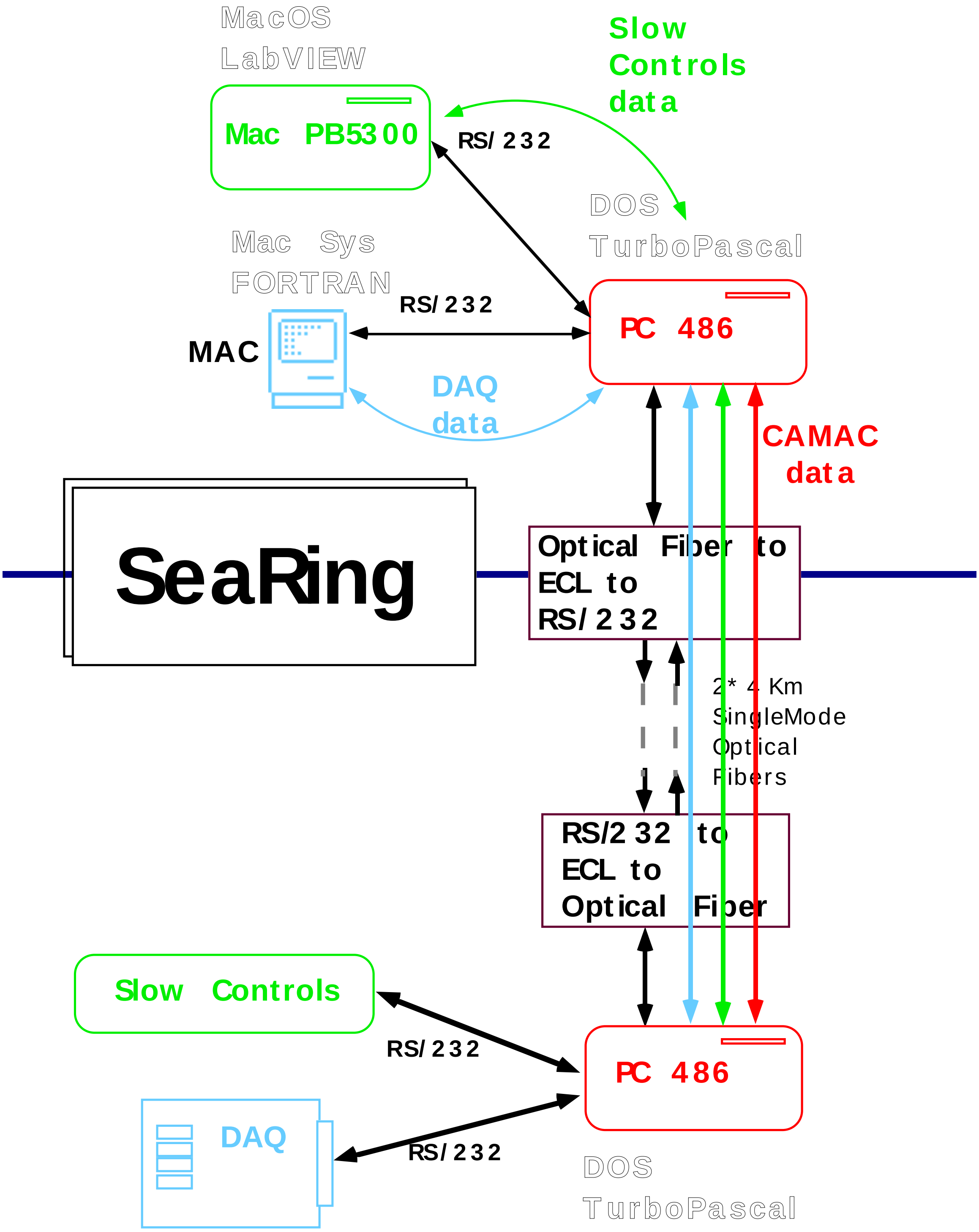

Fig. 3 – Data Flow schematic diagram.

2.1 – The Microcontroller

Each of the Slow Control units was built using a Hitachi SH7032 RISC microcontroller with external ROM and RAM, plus an additional board containing the interface with the hardware (see Fig. 4). The system implemented both readout of analog signals and relay output to control the photomultiplier power supplies. This capability is necessary in a deployment to turn on the PM power supply only when the apparatus has reached a depth where the sunlight does not arrive.

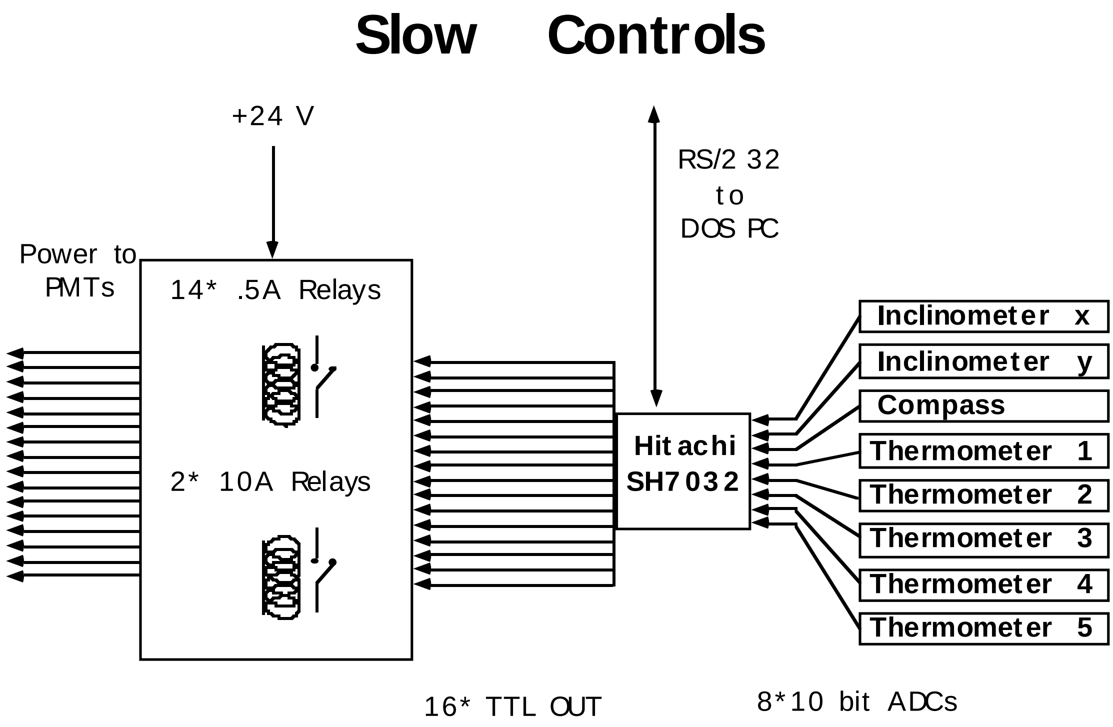

Fig. 4 – Slow controls schematic diagram.

Eight analog readout channels were installed, one for the readout of a compass, two for a bidirectional inclinometer and the remaining five to monitor the temperature inside the sphere in several positions, to check the heating due to the electronics inside.

3 – TEMPERATURE TESTS

The total power consumption inside the sphere was 250W. Two small fans insured air circulation inside the sphere. The experiment was performed during the night.

Fig. 5 shows the temperature distribution inside the sphere during the first two hours of the experiment.. The outside temperature was about 16 °C at the beginning of the experiment. The sphere was closed and water was poured on top of it continuously.

The sphere was closed at 12:40 AM, where the rise in temperature can be seen to start. The five curves were obtained by five different thermometers placed at five different locations inside the sphere, as shown in Fig. 2.

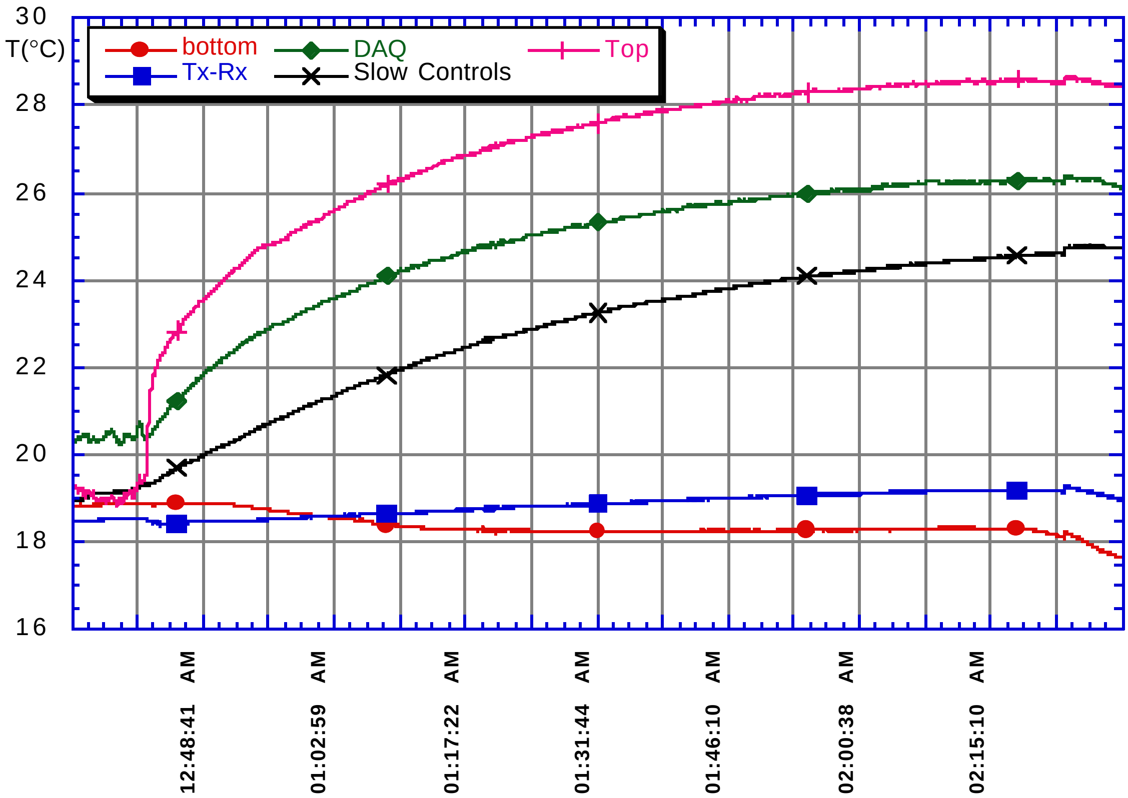

Fig. 5 – Temperatures inside the Ti sphere during the night.

The bottom one corresponds to the bottom of the sphere, where the cable delays are stored. The second one from the bottom corresponds to the second floor, where the optical Tx Rx system was installed. This system only dissipates 5 W. The third and fourth curve both correspond to the third floor, where the Slow Controls and the DAQ electronics were installed. In detail, the lower one was measured inside the Slow Controls box, which dissipates 2W, while the fourth was measured close to the hottest chip of the DAQ electronics.

The fifth thermometer was placed as close as possible to the top of the sphere, over the CAMAC crate that dissipates about 200 W.

The thermometers were not calibrated, and are supposed to be exact within 1–2 °C.

The measurement was interrupted by a power failure caused by a storm. The small decrease in all of the readings close to the end is probably due to the start of the rainstorm that caused the power failure.

Fig. 6 shows the same measurement taken in the morning.

The measurement was repeated a few nights later without any cooling water being poured on the sphere. The results are shown in Fig. 7. The position of the thermometers inside the sphere had been slightly modified. Thermometer no. 1 shows clearly a bad electrical connection.

All of these measurements were taken with external cooling and temperature conditions worse than the real experimental ones, where the sphere will be immersed in water at 14 °C.

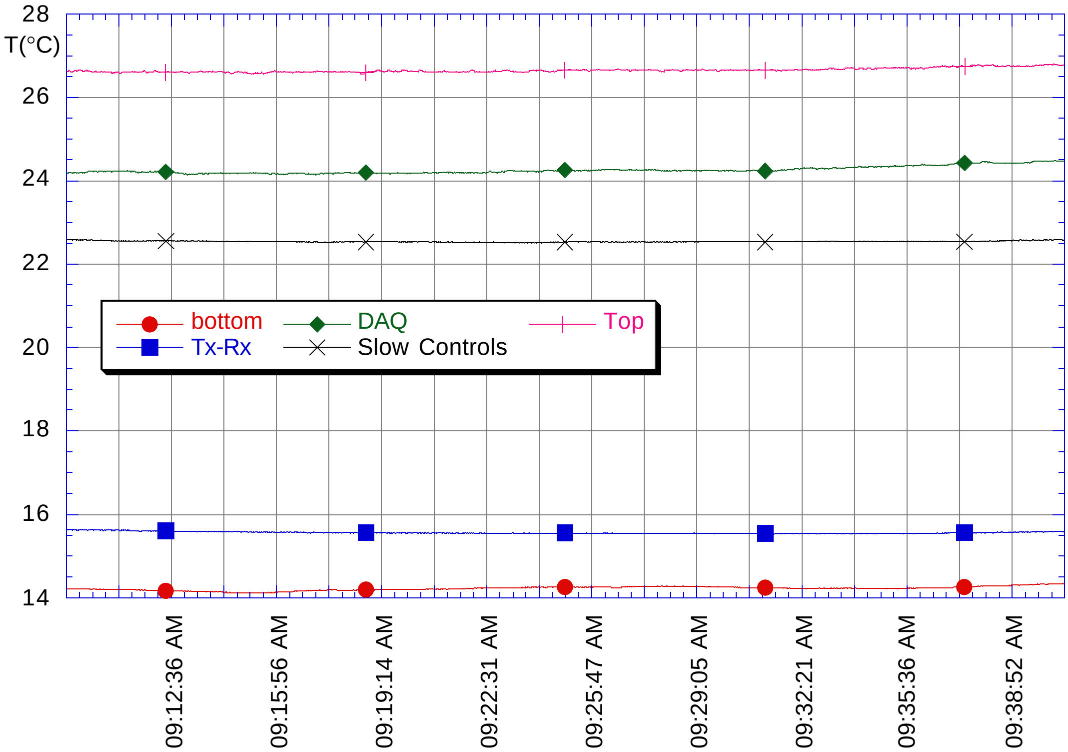

Fig. 6 – Temperatures inside the Ti sphere in the morning.

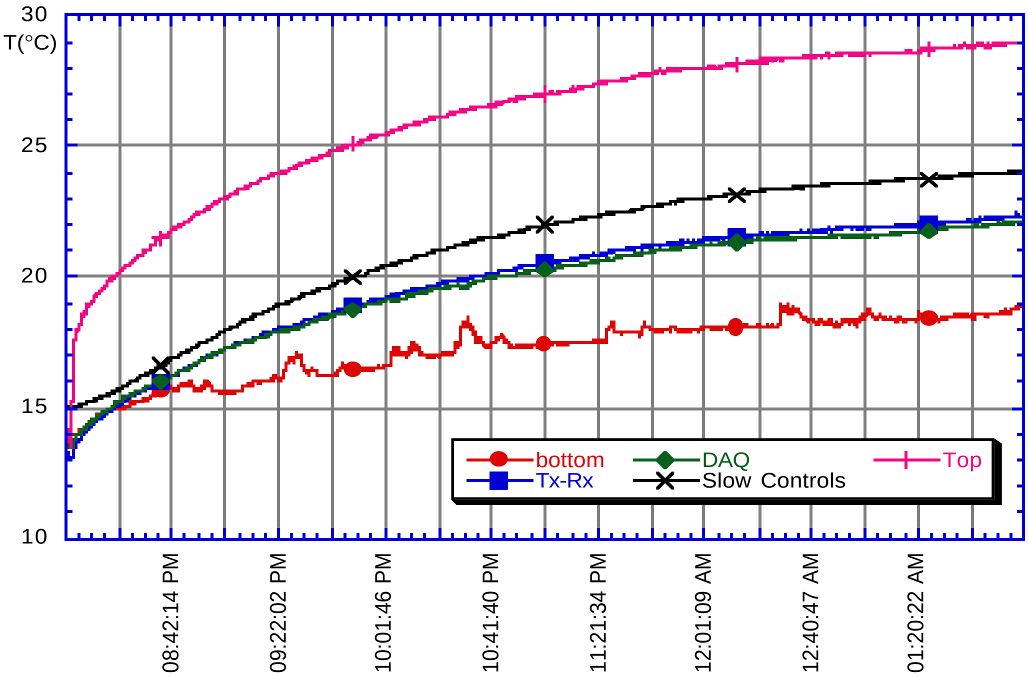

Fig. 7 – Temperatures inside the Ti sphere without any cooling.

3 – CONCLUSIONS

A prototype of the NESTOR Slow Controls System, CRONOS, was tested in the actual deployment frame and performed satisfactoryly. The temperature measurements performed allow us to conclude that in the NESTOR Ti spheres, arranged for the test deployment, the temperatures will be lower than 30 °C for all the electronic components.

REFERENCES

1) NESTOR: Deep underwater neutrino astronomy
NESTOR Collaboration, presented by L. Trasatti at the 1996 S. Miniato Workshop on Future Technologies

2) For a full description of the experiment and more detailed reports of the detector refer to: 2nd and 3rd NESTOR International Workshop, edited by L.K. Resvanis, 1992,1993