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The Installation of a new Transmission Monitor in Izaña in 2004 November

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Abstract

The transmission-monitor photomultiplier tube is replaced by a new transmission monitor based on a photodiode. A temperature monitor is installed. It monitors the temperatures of the outside air, the upstairs room, the spectrometer baseplate, the interference filter, the scattered-light photomultiplier tube, and the cell oven. It also monitors the right-ascension and declination guider error signals. A new BeebSub is installed.

1 Introduction

Steven Hale and Brek Miller travelled to Izaña on 2004 November 9 for a two-week visit to make some improvements to the zoo. The grand opening of the Izaña Zoo originally took place [1] on 2003 December 5. At that time, we did not implement any sort of temperature monitoring, data from the BBC Scalers [2] were read by the BBC Computer Substitute (BeebSub) #56A [3], and George Isaak was concerned about the amount of ice that had built up on the EMI 9658 photomultiplier tube (PMT) being used to monitor the scattered light.

The BeebSub #56A occasionally crashes. A new device, the BeebSub #56C [4], was built to replace the BeebSub #56A. A monitoring device, the Izaña Temperature Monitor [5], was built to monitor temperatures. And a transmission-monitor photodiode (not documented yet) was built to replace the EMI 9863 PMT transmission monitor (TM) in Mark I. The hope is that the room-temperature EMI 9863 might someday replace the ice-covered EMI 9658 as the scattered-light detector.

2 Transmission Monitor

The original transmission monitor (TM) was a room-temperature photomultiplier, specifically an EMI 9863. This unit was replaced by a new transmission monitor based on a photodiode. The detector contains a quarter-wave plate and a linear polarizer. These were aligned such that the detector would see either 100% transmission or 0% transmission depending on the orientation of the incoming beam, thus giving a constant transmitted ratio of 100%. This is useful since it allows us to determine the quality of the polarization produced by the Pockels-cell.

Unfortunately, the detector is placed perpendicular to the beam via a mirror, and this had unforeseen effects on the polarization. The best ratio we achieved was 66%. Nevertheless, this will still allow us to determine any changes in the performance of the Pockels-cell.

Once this new detector has been proven in service for some time, it is hoped that the now-spare EMI 9863 will replace the ice-covered EMI 9658.

3 Temperature Monitor

We installed the Izaña Temperature Monitor [5] on this visit. It now monitors six temperatures (ambient, room, interference filter, oven, spectrometer baseplate, and photomultiplier tube) and three voltages (right-ascension error, declination error, and oven power supply output). We encountered no problems during the installation.

The software (the program on the computer is called the lizard) writes two temperature data files every day. They are called *ityymmdd.dat* and *ivyymmdd.dat* where *yymmdd* is the date. The *it* file contains the daytime temperature data and the *iv* file contains the night-time temperature data. Both files are written to the */home/zoo/Results* directory on the station computer (*bison.ll.iac.es*). These files contain lines with ten columns of numbers as shown in Table 1.

4 New BeebSub

Since the opening of the Izaña Zoo nearly one year ago, data have been read from the scalers by the BeebSub #56A [3]. This device has suffered from several types of glitches. The most serious problem is that the PIC inside the device hangs. It was believed that this was because the seven-meter-long wires between the BeebSub #56A and the BBC Scalers connect directly to the pins on the PIC. Noise or surges on these wires may have been causing the PIC to crash.

A new BBC Computer Substitute, the BeebSub #56C was built in Birmingham. This new version incorporates buffers, terminators, and clamps on all of the input and output lines. It was hoped that this would prevent transient voltage spikes from causing problems for the PIC. It appears to have worked. The new BeebSub #56C did not crash once on our visit.

Table 1: Izaña Temperature Files

<i>Column</i>	<i>Symbol*</i>	<i>Description</i>
0		Time (hours UT)
1	amb	Ambient temperature
2	apex	Upstairs room temperature
3	spec	Spectrometer baseplate temperature
4	if	Interference filter temperature
5	pmt	Photomultiplier tube temperature
6	oven	Oven temperature
7	ra	Right-ascension error signal
8	dec	Declination error signal
9	ovpwr	Oven power supply output

*These are the symbols displayed by the squid for each reading.

The extra protection on the wires has also eliminated one of the other minor problems whereby the BeebSub would see a spike on the \overline{MT} (as in, “scaler buffer not empty”) and wrongly believe that data were ready to be transferred. This small problem did not cause any harm because the BeebSub would immediately attempt to retrieve the data from the BBC Scalers only to find that there were, in fact, no data available.

There were two other problems that were not related to the input and output lines to the PIC. These involved glitches with the communication between the PIC and the computer, which takes place over an RS-232 connection between the PIC and the Keyspan USB-to-serial converter. It was believed that the USB-to-serial converter was misbehaving. On this visit, the computer operating system was upgraded from RedHat Linux 9 to Fedora Core 2. The newer device driver for the Keyspan USB-to-serial converter seems to be working better. There was not a single communication glitch during our visit.

5 PMT Incident

We needed to remove the cover from the spectrometer in order to install the new TM. This is not a difficult thing to do and, with care, it is possible to remove and replace the cover without disturbing the optical alignment or any of the fragile components. We hoped to perform the installation on a cloudy day so that we would not lose any good data. Fortunately, the weather was cloudy on the first few days of our visit.

After the TM was installed, we needed to wait for some sunshine so that we could align it. The cover was off the spectrometer continuously for two days. We could have replaced the cover while we were not working, but we decided to try to minimize the number of cover removal/replacement cycles in the vain hope that this would minimize the disturbance to the instrument and its alignment. Instead, all we accomplished was to give the PMT cooler the opportunity to accumulate a lot more moisture. The ball of ice was considerably larger than

when we started. In fact, it had grown so large, that we could not put the cover back on the spectrometer.

We carefully “shaved” some ice from the cooler (making snow in the process). We were confident that we were gentle enough not to disturb the alignment. With the cover finally back on and everything reconnected, we applied power to the PMT. It did not work. The high-voltage supply was hitting the current limit at around 200 V. Normally, this tube runs at 2,600 V.

We spent the next couple of days worrying. This did not help much, but it did give us time to conclude that the only thing to do was remove the ice. Pere Pallé was in Paris and out of contact during this crisis. But before he left, he told us to contact Ezequiel Ballesteros Ramirez if we needed anything. We did, though he was not available immediately because it was a weekend. On Monday, he sent John Morrison. John took one look at the ice-covered PMT and said, almost immediately and without performing any tests, “We have to remove the ice.” So John’s men set about melting the ice with a heat gun. By early Monday afternoon they were done.

We dried everything overnight and then tested the PMT on Tuesday morning. It still did not work. We contacted Teo Roca Cortés and asked permission to remove the PMT. He agreed to this. Removing the PMT was not as difficult as we feared. We found a small amount of water inside the metal tube and some residue on the connections at the back. We cleaned and dried everything and tested the PMT. It worked!

There was a hand-written note on the side of PMT which read, “Tube suspect, very low gain, dark 2.5 k at 2.2 kV warm!!” Teo recognized it as Bob van der Raay’s handwriting. Teo says that Bob thought all of the tubes were suspect.

We put the PMT back into the spectrometer, connected it up, and turned on the power. It still worked! Teo helped us to realign the spectrometer.

6 Autoguider Differencer

Early in our visit, Pere explained that they were having problems with the autoguider electronics. There are three pieces of electronics that control the position of the primary mirror. The four photodiodes (not one quadrant photodiode) in the autoguider telescope are connected to a box that I shall call the “autoguider differencer”. It produces two error signals, one for right ascension (RA) and one for declination (DEC). The RA error signal is fed to a box that controls the speed of the RA motor. The DEC error signal is fed to a box that controls the DEC motor.

Pere told us that the problem was with the power supply inside the autoguider differencer. The internal 5-V supply was working, but someone had had to connect an external ± 15 -V supply to the differencer.

We expected that the problem was with the 7812 and 7912 ± 12 -V regulators; however, when we reconnected them and tested them in the circuit, we found that they were working normally.

We decided not to reconnect the external supply. The autoguider differencer worked correctly for the remainder of our visit. We did periodically check the temperatures of the regulators, but nothing seemed amiss.

We guess that perhaps there was previously a problem inside the autoguider differencer (a short somewhere, perhaps) that was causing too much current to be drawn from the regulators making them shut down. This problem was probably cleared when the wires were rearranged to accommodate the external supply.

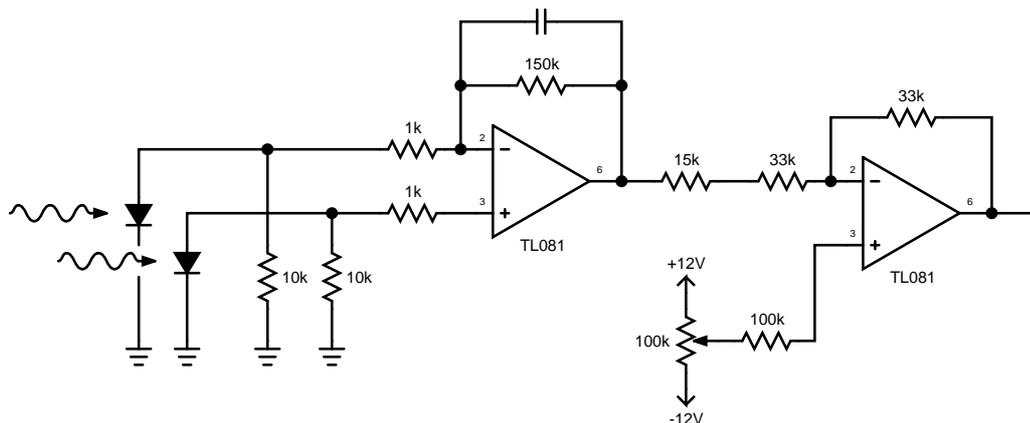


Figure 1: A partial schematic drawing of the autoguider differencer.

While we were examining the autoguider differencer, we made a note of part of the circuit inside. It is built on a piece of Veroboard. We did not remove the Veroboard so we could not make a complete circuit drawing, but we were able to learn that the photodiodes are being used in voltage mode. The partial circuit is shown in Figure 1.

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