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A 15 Metre Submillimetre Telescope on La Silla

During its last meeting, on 7 June 1984, the ESO Council approved the agreement between the Swedish Natural Science Research Council and ESO on the joint installation and operation on La Silla of a 15 m submillimetre telescope and the agreement between IRAM and ESO under which IRAM will provide the telescope.

The observing time will be shared equally between Sweden and ESO. Much of the technical responsibility for the project would lie with the Onsala Space Observatory which operates a 20 m millimetre telescope at Onsala. The Swedish/ESO Submillimetre Telescope (SEST) is scheduled to become operational in 1987.

Director General Reappointed

Prof. L. Woltjer has been reappointed by the ESO Council to be Director General for the period 1 January 1985 to 31 December 1989.

The Remote Control Run from La Serena, June 10–17, 1984

G. Raffi and M. Tarenghi, ESO

With the expenditure of missions from Europe to Chile showing a steady increase, not only because of flight prices but also because of the rise in infrastructure upkeep of remote sites, along with a clear tendency to lower the cost of satellite transmission, it seems to us that remote control will become an economical system to operate telescopes.

It is important to underline here that the economic factor is not the only one, and probably not even the major one. The real reason for the modern tendency towards remote control is the hope to make better use of our present and future telescopes. Possible advantages directly or indirectly coming from remote control are:

(1) The telescope can be located on the best possible site, which may in itself not be comfortable for astronomers.

(2) Larger groups of astronomers can participate in observing programmes.

(3) Better use of telescope time. Scheduling of telescopes becomes more flexible and it will be possible to make maximum use of the best seeing nights.

(4) Better collaboration between technical maintenance in Chile and Europe will result. Instrument tests will have the advantage of being carried out under the control of a larger technical team, and in particular by the group who assembled the equipment in Europe.

We are investigating possible systems of communication between the observatory and Europe. The transmission of data between the telescope control system and some type of data processing and visualization equipment in Garching should include the transmission in real time of the telescope's field image and the instrument's data and, in the reverse direction, the transmission of the control commands.

If the operation of the telescope cannot be fully automated, a means of communication between the observer in Garching and a night assistant in La Silla must be provided.

Change of ESO telephone number in Santiago

Please take note that the telephone number of La Silla via the ESO Santiago office has been changed from 88757 to **6988757.**

In the case of the NTT, it is intended to implement remote control as a connection of two computers via a long-distance link. Clearly this approach gives some advantages, such as:

– Communication reliability can be increased by retransmissions to such a level that all transmission errors are eliminated.

– The raw data can be sent from one computer to the other. An obvious implication of this is that the full power of an image processing system on the user-end computer can then be applied at will to the data. Furthermore, the user has the data available to him already at the end of his observing night.

To clarify these advantages better, one should think of the alternative of simply having a terminal connected via a long-distance link to a distant computer. In this case all graphics, etc. must be computed on the host distant computer and the result (e.g. a plot) must be sent down the line each time to the user's terminal.

On a slow speed line this requires time, and the terminal does not have the "intelligence" to correct transmission errors, which will probably destroy the graph and the raw data will not be available to the user.

A remote control run from La Serena, last June, was a first relevant step in this direction.

The Technology Used for the La Serena Run

The 2.2 m telescope of ESO was chosen to run this experiment because its control/acquisition software was implemented in a manner suitable for remote control, even if not initially written explicitly for this, and because an autoguider was available on it. The instruments used were a Boller & Chivens spectrograph with CCD detector and a CCD for direct imaging.

The two computers connected were two HP 1000 systems, one in the 2.2 m telescope and the other in the ESO office in La Serena.

The line in-between was leased by the Chilean PTT Entel and was based on a microwave link from La Silla to the Entel office in La Serena plus a short VHF link in La Serena. The frequency band used was a normal telephone band and Entel provided also modems at 4800 baud.

Fig. 1: *La Serena, 16 June 1984. The control room at the ESO La Serena office, during a measurement of the seeing of the La Silla sky.*

In practice we used different modems (synchronous) at 9600 band, which supported also telephone voice communication as an alternative to data transmission.

The Remote Control Software

The communication software was based on DS/1000, at the top of which a package was built to allow programme to programme communication via mailboxes over a link. The control/acquisition software in the 2.2 m had already been built around modules exchanging commands via mailboxes. What was needed for remote control was to separate some of these modules (the "user end") from the others (the "controller" or instrument/telescope end). The "user end" programmes dealing with softkey input and input-output tables were modified to interact with the remote control package.

The "controller" modules remained unchanged, which means that they could run either locally or remotely.

The "user end" programmes were also unchanged as far as appearance to the user is concerned.

Special attention had to be paid to the usage of the image processing IHAP programme. The data acquisition was done on the La Silla computer, reading data into a disk in the IHAP data-base and putting them on tape there.

The IHAP programme at La Silla, called remote IHAP, was made available also to the user in La Serena, allowing a number of examinations on the acquired data. The transmission of data from the La Silla computer to the user-end computer was carried out typically with a file to file copy programme.

A data compression programme was also tested, which allows the sending of data in compressed form without loss of information. An additional advantage of this is the capability to transfer data from remote IHAP to local IHAP and to do a display on a Ramtek display at the same time. By "local IHAP", the IHAP on the user-end computer is of course meant.

Capabilities Offered

The capabilities offered in La Serena are described below.

- The same user interface to instruments (Boller & Chivens and Adapter with CCD) as in La Silla at the 2.2 m telescope and the same devices (instrumentation and graphic terminal, Ramtek image display) were available.

- An extra feature, with respect to normal observation, was the access to both local IHAP (on the La Serena computer) and remote IHAP (on the La Silla computer).

- It was possible to preset, offset, and focus the 2.2 m telescope via the instrument programme. This is an option available also at La Silla, when the user defines an exposure. The instrument programme takes care of sending the appropriate commands to the telescope control system.

- In principle it is also possible to use directly the telescope control system console from La Serena under remote control, having access to all the functions of the telescope. However, operationally it proved to be unnecessary and the telescope control console was left to the night assistant in La Silla, who used it mainly to start autoguiding.

- Data transmission was carried out and was available in two ways.
  – file to file transfer (data were copied from the IHAP database to a file and sent down the link as any file).

– IHAP to IHAP communication directly with data compression. (The data compression programme extracted the data directly from the IHAP data-base and also optionally cut them before transmission.)

The transmission of full raw CCD images (320 × 512 pixels) took about 7 minutes. However, images were normally either cut with threshold levels or truncated to a subset of the full image. This allows the reduction of the size of images to some 10–20 %, even without (or before) using data compression.

It is interesting to note anyhow that operationally, the data transmission times went "unnoticed" as, typically, data were sent across the link while the next CCD exposure was taking place.

Data transmission does not clash either with sending commands to the instrument or telescope, as this involves a short exchange of messages on the line.

- An interactive message system was also used to send/receive messages from a dedicated console. This was constantly active and working together with all other operations on the link.
- A voice channel was available as an alternative to the data channel. This is useful in situations like start-up, rebooting, etc. and was routinely used, e.g. during exposures to obtain information in a more direct and informal way than via a message system.

Conclusions

The operation from La Serena proved to be feasible both for the spectrographic mode and imagery. However, particularly for spectroscopy, the addition of a device to digitize the field image of the telescope, and transmit it to the remote site, which was not yet available at this stage, is planned and will be necessary.

Next Step

The next logical step is to observe from Garching. Various technical alternatives to do this will be possible. They basically are:

– Direct link via satellite transmission and an antenna in La Silla.

– Direct link via a satellite link from Santiago shared by ESO, plus a dedicated telephone line to Santiago.

– A dedicated telephone line to Santiago plus access from Santiago to a public international computer network. In this case, in practice, data would be routed via a computer in Santiago to a USA computer via a communications satellite link and from there to Europe.

We expect that this last possibility will become available in a few months as a service. A test with this might be relatively cheap to run and would take us one step further in the direction of having remote control for the NTT.

We would like to thank M. Ziebell for his contribution to the project, P. Biereichel for his data compression programme, D. Hofstadt and the TRS staff for handling the lease contracts with Entel and for the support in Chile.

Tentative Time-table of Council Sessions and Committee Meetings in 1984

October 8–9	Scientific Technical Committee, Chile
November 13–14	Finance Committee
November 27–28	Observing Programmes Committee
November 28	Committee of Council
November 29–30	Council

All meetings will take place at ESO in Garching unless stated otherwise.

Oxygen Abundances in Metal Poor Stars

R. G. Gratton and S. Ortolani, Osservatorio Astrofisico di Asiago, Italy

Introduction

The study of the chemical composition of old stars may give us interesting information about the early phases of evolution of our Galaxy. The Big Bang may have formed only a trace of elements heavier than Be. It is quite consequent that the early generation of stars in our Galaxy (and in any galaxy) must have formed with a low metal abundance; the metals were then formed in the interior of these early stars and returned to the interstellar medium through stellar winds or supernova explosions. Successive generations of stars formed with an increasing metal abundance. This picture is substantiated by the relation existing between metallicity and galactic orbit eccentricities shown by Eggen et al. (1962); this is interpreted as the interaction between a fast collapse of the gas component of the galactic halo and the increase of the mean metallicity of the same gas.

Many points are still obscure in this picture; the absence of observations of very metal poor stars seems to indicate that the Initial Mass Function (IMF) may have been different in the past, being strongly biased to massive or even super-massive stars ($M > 100\ M_{\odot}$). The evolution of these candidates to the first generation of stars is far from being clear (see e.g. Woosley et al., 1982); there is the strong suspicion that they may form large quantities of Oxygen but very small amounts of Iron. On the other side, type I supernovae are probably efficient Fe makers, while there is no available indication of the presence of Oxygen in their ejecta. As type I supernovae do not follow the arms of spiral galaxies and are present also in ellipticals, we think that the lifetimes of their progenitors are long. Thus the timescale of production of Oxygen (and some other light element) may be substantially different from the timescale of Iron (and other heavy elements) production.

It seems thus interesting to study the behaviour of the O/Fe ratio with time. Unfortunately it is quite difficult to derive sufficiently accurate ages for population II objects. We may however assume that age is correlated with metal abundance. This hypothesis is probably good in the solar neighbourhood, though it may be dangerous to extend it naively to other galactic regions.

Observations and Analysis

Early attempts to derive Oxygen abundances for metal poor stars have been made by Sneden et al. (1979) and Clegg et al.