

Figure 2: Ray Wilson giving his retirement speech at ESO Headquarters in Garching, April 2, 1993.

that those stunning first-light images in March 1989 (*The Messenger* No. **56**) changed overnight and forever the way that large telescopes will be designed: On-line wavefront analysis and active optics will be – no, *are* already – a must. A number of professional honours have been bestowed on him for this achievement, and well deserved they are.

In a wider perspective, the NTT demonstration also gave confidence that the thin VLT mirrors can be adequately controlled in practice. This not only considerably eases the figuring tolerances, but the novel feature that Cassegrain, Nasmyth, and coudé foci can be fed with a single secondary mirror depends on the ability to adjust the shape of the active VLT primaries.

Yet, achieving and maintaining the best optical quality of *all* telescopes has been Ray's lifelong ambition, a sustained long-term effort with the NTT as its splendid culmination. Figure 1 shows Ray back in 1978, contemplating on the carefully designed system for aligning and testing the optics of the Danish 1.5m telescope – another effort promptly rewarded with success (*The Messenger* **17**, 14). With on-line, turnkey wavefront analysers rapidly becoming available, poorly-supported and -collimated mirrors will soon be as socially un-acceptable as dirty ones, also on smaller telescopes.

Thus, although it is hard to believe, Ray celebrated his 65th birthday on March 23 and left ESO after more than twenty years. On April 2, the occasion was marked with a small symposium in Garching. In his final address (Fig. 2) he conveyed, true to form, the lessons and admonitions the rest of us should keep in mind after his retirement (note how little this young man changed between Figures 1 and 2!).

"Retirement" is, however, a rather misleading term for Ray's present activity: He is hard at work for a stern taskmaster - himself. The first draft of a twovolume book collecting a lifetime's experience with astronomical optics is ready, but he expects another year of full-time work before it is completed to his satisfaction. Uniquely, it will treat both the design, testing, alignment, and support of telescope optics - no doubt an indispensable reference for telescope builders for decades to come. Meanwhile, Ray defers all social invitations until "WTBIF": When The Book Is Finished!

Remote Observing with the NTT and EMMI/SUSI: a First Assessment

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Introduction

Although some observatories started earlier and others are catching up very quickly, ESO at the moment probably is the ground-based optical/IR observatory with the largest experience in routine remote observing. The Coudé Echelle Spectrometer (CES) at the Coudé Auxiliary Telescope (CAT) on La Silla has been used regularly by Visiting Astronomers at ESO Headquarters in Garching since 1988/89. In the present Period 51, usage will reach almost 110 nights or about 60% of the available time. During 497 nights in the four years of 1989–1992, the availability averaged 98.9%, and the downtime has always been less than that caused by instrument or telescope failures (for a more detailled report see Baade 1993).

Recently, a technically rather different system has been put into operation for remote observations with the New Technology Telescope (NTT), the ESO Multi-Mode Instrument (EMMI) and the SUperb Seeing Imager (SUSI). Its technological foundations have been described by Wallander (1990, 1993) and permit it to be used also from places other than Garching (Balestra et al. 1993, Franchini et al. 1993). Here we wish to give a first assessment of the performance of this remote control (RC) system during observing programmes carried out by Visiting Astronomers.

Does it Work?

Although this is still the most often heard question, already our first test nights convinced us that the answer is yes. The more relevant question is how competitive remote observing will be. We now believe that, as for the CAT/ CES, the limiting factor will eventually be the communication between Garching and the maintenance and operations staff at La Silla. This task is by no means trivial. On La Silla, maintaining coherence between the two alternating weekly shifts alone already requires continuous attention. Even more difficult is it for La Silla to integrate a third crew which is based on another continent where the working hours are at least 4–6 hours out of phase with the Observatory.

Our optimism includes all programmes except those consisting of very short exposures, each of which requires inspection by the astronomer before the next observation can start. Because of the limited bandwidth of the link between La Silla and Garching (48 of the total of 64 kbytes s⁻¹ are used for file transfer), such programmes are not suitable for remote observing. However, the fraction of such programmes is much smaller than most people would assume, and even then a slightly more detailed analysis often shows that only a fraction of the original CCD frame is really required for the on-line evaluation. Transmission of a 1k × 1k image takes 4 minutes; with destructive data compression, which is fully adequate for many purposes, this time can be halved.

Since the beginning of Period 50 (1992 October), we have supported 8 regularly scheduled observing programmes with a total of 17 nights. In addition, 8 test nights have been used to familiarize ourselves with the telescope and the instruments and to try out a wide variety of different instrument modes and telescope operations. These tests included:

- optimizing operation of the sophisticated video transmission system
- automatic and manual acquisition of guide stars
- offsetting the telescope without losing the guide star
- positioning point as well as extended sources on the slit, under both visual control (bright sources in modes REMD and BLMD) and software control (RILD and faint sources in modes REMD and BLMD)
- using the dichroic beam splitter in EMMI
- multi-lamp wavelength calibration exposures with EMMI
- checking various flatfielding procedures for EMMI and SUSI
- focussing NTT and EMMI
- switching between EMMI in Nasmyth station B and SUSI in Nasmyth station A: the first time M3 got stuck (not related to remote operations); since then we have stayed within the nominal 5-minute time frame.

The most recent function we tested was multi-object spectroscopy (MOS) in EMMI's RILD mode. This is a non-trivial

operation because the required masks are punched within EMMI. But unlike the PUMA machine at the 3.6-m, this of course makes it suitable for remote control, and it worked very well. The only major task we have not so far undertaken is the image analysis and subsequent setting of the active optics system of the NTT. We have postponed this for a few months until the new control software and beam splitter have been commissioned which will permit a continuous image analysis using 80% of the light received from the guide star (the remaining 20% being used by the autoauider).

In principle all relevant telescope and instrument manoeuvers can be carried out remotely. However, an important purpose of the tests was to identify how telescope and instrument operations are best shared between La Silla and Garching. For instance, the analysis of a focus image can obviously be done more efficiently by the night assistant. But the observer can still transfer the image and check the focus value during the next exposure. The manual acquisition of a guide star is also faster when carried out locally. On the other hand, identifying a target in a crowded field or deciding about slit offsets or position angles can often only be done by the observer. Since he can communicate more easily with the remote control operator in Garching, who is assisting throughout the night, the latter will usually carry out the resulting telescope operations.

Turning to the 17 nights of regular observations, the evaluation of the observer's reports and our own records shows that the fraction of time lost to poor weather and to technical problems on La Silla amounted to 10.6 and 2.1 %, respectively. A further 3.8% was lost as a result of technical problems with the RC system. This number still compares acceptably with the average total technical downtime of 4.7% during the whole of Periods 49 and 50, especially since more than 75% of the RC-specific losses occurred during the first night and were caused by the fragility of the Ethernet at the NTT. Since then, rebooting all computers on both sides at the beginning of the night has improved the performance considerably. Finally, for another 3.6% of the time the observations had to be continued by the night assistant in La Silla according to instructions transmitted by telephone from Garching because the link was temporarily lost. Here, complaints to the responsible telecommunication companies seem to have brought about significant improvements.

Almost all observers assured us that they find the system very easy to get

acquainted with. A decisive advantage of the system is a simulator mode. It permits full introductions to be given at any time and only requires a computer and a terminal in Garching. Observers can then repeat operation sequences as often as they like and without having to worry about negative impacts on the equipment. Simulators are available for all instrument modes of EMMI (plus SUSI) and the NTT itself. However, during observations, the NTT is operated only by the night assistant on La Silla or the RC operator in Garching; as in local mode, the observer is in charge of all instrument manipulations.

What is the Gain?

The experience with the CAT/CES has shown that the acceptance of remote observing is very high as long as observers experience high reliability and good support. For NTT observers whose programmes are generally assigned only a few nights, the advantage of not having to travel the long way to South America is even more obvious than for the often longer observing runs at the CAT. Remote observing also offers the opportunity for young astronomers to be introduced to modern observing techniques: ESO provides financial support to students, who are involved in a remote observing programme, to accompany a senior observer. The same is not possible for travel to La Silla. Since the NTT RC software can furthermore be run in a so-called eaves dropping mode in which an astronomer in Garching can closely monitor the operations on La Silla and for instance help with the online data reduction and quality control, remote observing could be of interest also in connection with service observing.

From the long list of acknowledgements below one might get the impression that the support of remote observing with the NTT requires an enormous effort. However, it must be kept in mind that the NTT RC system has so far been used for only 25 nights and we are therefore still on a relatively steep portion of the learning curve. In spite of this, the success rate is already quite satisfactory, and we see nothing to prevent the NTT system from reaching the same reliability and efficiency as the one in use with the CAT/CES.

In particular, we expect the involvement of non-operations staff in NTT remote observing from Garching to diminish in the near future. In fact, much of this additional effort does already today not so much concern the support of remote operations as such. It increasingly results from the recognition of general insufficiencies which via the RC activities could be brought to the attention of the relevant experts in Garching.

This "side effect" and remote engineering had since the initial planning been part of the expected scientifictechnical returns of remote observing. But we are happy that already after so short a time we can report a number of concrete examples:

- Until recently, CCD controllers on La Silla did not deliver the full 16 bit resolution of the analogue/digital converters to IHAP, which is still used to produce the "official" data tapes, and the most significant bit was lost. Now observers are (soon will be) able to request the full dynamical resolution. (This concerns many more CCD systems on La Silla than just the ones of EMMI or SUSI).
- The reason why a small fraction of EMMI/SUSI data files had no FITS header attached to them was identified.
- It is now understood why the automatic guide selection procedure often spuriously reported that no suitable guide stars were available for a given field.
- A subtle bug was discovered in one of the special batch programmes which are needed to centre sources on the slit in the spectroscopic modes of EMMI.

To this can be added a number of other minor NTT problems, and also a bug in the CES software which had a 1:6 chance of prematurely aborting an ongoing exposure.

The experience of confronting various colleagues with such problems has been a very good one because the responses have been very positive. In all cases, the problems were settled so that EMMI/SUSI observers, both remote and local, are now better served. The considerable shortening of the feedback loop between Garching staff and their products on La Silla is an important spin-off from remote observing. The experience is relevant to the VLT, for which remote engineering will probably play a key role.

Who Contributed?

That we have been able to support remote observing with the NTT is the result of generous and dedicated support from very many people. On the La Silla side, Gaetano Andreoni and Christian Levin helped to iron out a couple of software and networking problems. The Operations Group not only did the instrument setups but also remedied various problems during the observations: in test nights, this sometimes included problems induced by our own lack of experience. We appreciate the patience of their coaching. A special word of thanks goes to Nicolas Haddad for having navigated us through the various steps of the preparation and execution of MOS mode observations. Finally, the continuous advice by the night assistants on La Silla, particularly Jorge Miranda and Manuel Pizarro, on how to keep the NTT under control, was very essential for our progress.

In Garching, Anders Wallander, as the responsible software development engineer, has shown a great interest in understanding and solving even the smallest problems and thereby provided much encouragement. Hans Dekker and Sandro D'Odorico taught us much about the intricacies of EMMI. Hans and Anders also helped to further optimize the layout of the graphical user interface to EMMI and SUSI. The interface is easy to operate and at the same time reflects the physical functionality of EMMI so that observers quickly get a feeling for what the instrument is actually doing. For the implementation of some of these modifications, Mauro Comin's insights into the CFHT's Pegasus software were essential which in its original form could not accommodate all our needs. Antonio Longinotti, Eric Allaert, and Peter Biereichel gave advice on some aspects of the data acquisition software and developed a number of enhancements. Training sessions with the autoguider and the guide star selection and acquisition software were provided by Krister Wirenstrand, and Lothar Noethe introduced us to the image analysis procedure. Substantial improvements were achieved by Manfred Ziebell who convinced the Deutsche Telekom and ENTEL Chile how important it is that the link is up 100% of the time.

The help of our colleagues was vital not only to get remote observing with the NTT off the ground but also to continuously optimize NTT remote operations. This is a long-term effort and often involves aspects of seemingly ridiculously low relevance such as the terminal mode during text input operations (insert or overstrike), the font size used for the remaining exposure time, the format and jargon of the oral communication between night assistants on La Silla and operators in Garching, and the scaling factor between translations of the mouse and the resulting movements of the cursor on the screen. It is indicative of a good team spirit that in all cases the perceived needs of the observers could be taken into account as long as fundamental technical limitations did not prevent this.

While ESO's visitor facilities are tested by ESO's astronomical staff, the final assessment can only come from Visiting Astronomers for whom the system was developed. We are, therefore, most grateful to those applicants for observing time who had the courage to opt for this new observing mode. Through their experiences and comments we have learned a lot, and we shall try to convert their suggestions to the necessary improvements. All reqularly scheduled remote observers have so far reported that they achieved the aims of their programmes. We realize, of course, that this includes the expectation that next time the efficiency will be higher. That the efficiency (not to be confused with the downtime discussed above) is not yet perfect cannot surprise after so few nights of practice with a fairly complicated instrument and telescope. However, for this same reason we are confident that this goal can be met.

Interested?

The purpose of this report is not to give a full description of the NTT RC system. For more complete information, please contact the Visiting Astronomers Section in Garching (Internet: visas@eso.org; SPAN: eso::visas; EARN: visas@dgaeso51). A very detailed RC users guide for EMMI, SUSI, and the NTT by Anders Wallander has become available very recently (there is another one for the CES). The remote control team will be happy to answer any questions you may have – just con-

IMPORTANT NOTICE APPLICATIONS FOR OBSERVING TIME AT LA SILLA

PERIOD 53

(April 1-October 1, 1994)

DEADLINE has been changed to: October 1, 1993

The Announcement will be issued end of July, 1993. Please note that **no new Key Programmes** will be considered for Period 53. tact us. (From June 1, the scientific responsibility for remote observing has been passed from DB to George Meylan.)

References

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- Franchini, M., Molaro, P., Nonino, M., Pasian, F., Ramella, M., Vladilo, G., Centurion, M., Bonifacio, P. 1992: *The Messenger* No. **69**, p. 6.
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A Two-Colour Composite of IC 1396

The composite photo provides a good illustration of the usefulness of two-colour work in astronomy.

Two photographic plates for the Palomar/ESO Atlas of the Northern Sky (now being reproduced at ESO) of fields 146 (R) and 188 (B) were enhanced directly without any masking to reveal the





fine details in the dust and gas clouds of this nebula which covers almost two complete fields. The amplified films were then copied onto llfochrome colour paper through a monochrome colour filtre. The overlapping area appears as a two-colour composite which makes it possible to separate directly objects of different colour. Great care had to be taken to obtain the best possible superposition of the two plates, especially as there are slight differences in the plates near the edges.

Unlike most present-day astronomical observations, this composite provides a very-wide-field image of a sky area of about $6^{\circ} \times 10^{\circ}$.

The second photo is an enlargement of an area east (left) of the centre of the larger one. There are lots of interesting details. Note, however, that some of the rectilinear shapes in the nebula are at least partly due to the reflection pattern of a very bright star seen in the upperright part of the "red" image.

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