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ESO 1993 to 2000 plus*

R. GIACCONI, Director General of ESO

Introduction

The very complete "History of the European Southern Observatory (ESO)" prepared by Prof. Blauuw furnishes a perfect background for my presentation on the present status and foreseeable future trend of ESO. I will therefore not repeat many of the basics regarding the creation, membership charter and early development of ESO except to summarize the most significant starting points for current and future activities. From its beginning in 1962 and through a number of successive developments outlined in Prof. Blauuw's report, ESO's observational facilities in La Silla grew in number throughout the first 30 years so that in 1993 they comprised 15 telescopes of all sizes and descriptions ranging from the 3.6 meter to 50 cm telescopes and including ESO's and national facilities. This is the basis of the statement that ESO runs one of the world's largest astronomical observatories.

As far as the quality of the observational capabilities is concerned, the most significant event was the study, development and construction of the 3.5 meter New Technology Telescope (NTT) which was initiated in 1980 and inaugurated in 1990. In the realization of this project ESO for the first time introduced technology which was ahead of the state of the art in the world. This development provided the technological foundation for the much more ambitious Very Large Telescope (VLT for short) project which was approved by the ESO Council in 1987.

With the approval of the VLT project the European Astronomical Community and ESO have decided to construct optical ground base facilities comparable, or superior, to any existing in the world. When the VLT array is completed in the first few years of the next century, it will furnish the largest integrated collecting area of any array in the world (200 square meters) as well as the most powerful interferometric capabilities and will come into operation in one of the most favourable astronomical sites in the world (Cerro Paranal).

The realization of this project has required profound changes in the organization while the project itself is being conducted. It has also strained the financial resources of ESO, and has forced a careful reassessment of priorities in order to establish a strategy for ground based optical and IR astronomy. In particular, the role of the La Silla Observatory during and after the development of VLT on Paranal has required a great deal of attention.

A further and important consideration needs to be introduced. The construction of large telescopes is a condition necessary but not sufficient to ensure the competitivity of European astronomy in the world. Just a trivial example: the notorious lag in development of optical CCD detectors in Europe has meant a loss of efficiency in the observations of about 50 %. It is evidently useless to build large telescopes, if we do not use them effectively. This implies the construction of forefront instrumentation and its proper use.

By proper use I mean the study and implementation of an end-to-end system for science operations. This includes: strategies for telescope utilization, ranging from traditional modes to service and remote observing; scheduling of observation (both long and short term) to best utilize the seeing qualities of the site; systems for data acquisition, calibration, reduction, distribution and archiving. By implementing this overall vision of how to carry out modern astronomical research, ESO indeed holds the promise of becoming the leading optical

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observatory world-wide. In what follows I will describe the progress we have made in some of the areas mentioned above and the prospects for the future.

Construction of the VLT and the Paranal Observatory

The construction of VLT has been a new and unique challenge for ESO. When completed in 1987, the cost of the NTT telescope corresponded to less than the budget of ESO for one year. The VLT total cost corresponds to 8 times ESO's yearly budget. The cost to completion, including internal and external costs, will amount to more than 1 billion DM. The execution of this undertaking has required a complete revamping of the administrative, accounting and managerial structure of ESO with the introduction of modern management tools appropriate for a project of this size. During early 1993-1994 Work Breakdown Structure accounting was introduced first for VLT and then for ESO as a whole. In this approach each major task is assigned manpower and financial resources and a responsible person is placed in charge of its completion within a fixed schedule. Progress is reported on VLT in biweekly programme meetings and formally in two programme reports to Council per year. Once a year ESO wide reviews are conducted in which goals and objectives for each division are discussed. The adoption of these techniques was recommended and /or endorsed by an outside consulting committee chaired by Prof. Lund and supported by an industrial firm (Lurgi) in early 1994.

In the last few years the VLT project has substantially maintained schedule notwithstanding the adverse impact of the issues which have arisen with the Chilean Government. The first completed mirror will be delivered in Paris (by the Reosc firm) on November 21. The steel structure for the first telescope is being assembled and tested at the Ansaldo firm in Milan for delivery to Paranal in June 1996. The rest of the hardware and software is on schedule for a first light at the end of 1997 and commissioning by June 1998. The other three telescopes are on schedule for completion of the array by 2001. The interferometric use of the 4 telescopes of 8 meters and the auxiliary three telescopes of the 1-2 meter class had to be delayed due to financial constraints. However, the full infrastructure required for the implementation of VLTI is being prepared on Paranal. The civil engineering portion of the construction is almost completed and the erection of the telescope domes is well under way. An essential difference between the construction of NTT on La Silla and VLT on Paranal is that the realization of the VLT project has required the simultaneous creation of a new observatory in the Atacama Desert with all the appropriate logistic support.

The construction of the VLT and of the new observatory on Paranal has required an increase in the staff and in the budget. We have analyzed the efficiency with which the ESO staff operates the La Silla facilities and compared our findings to the reputedly best run observatories in the world. We find that ESO runs its facilities with efficiency comparable to the best.

Even with this level of efficiency, however, the operation of VLT would be too expensive given the magnitude and complexity of the task. We have therefore "reengineered" our operation plans at the outset and we plan to operate Paranal (4 x 8 m telescopes + 3 x 2 m telescopes) with a smaller yearly budget than La Silla. We do not yet know at what level the community will wish to maintain La Silla facilities during the VLT era (see discussion in the next section). In this section we have assumed no change to the La Silla effort before or after first light on UT-1. This will certainly not be the case and ESO will reduce La Silla facilities to those essential to complement the VLT following the recommendations of the "La Silla 2000" study.

The budget is projected to remain at a level of 141.5 MDM (in 1995 values) until the payments to outside contractors for VLT are completed in 2003. The staff complement projections under the same assumptions are for 253 international and 236 local members.

Role of La Silla during and after VLT construction

The problem of developing a strategy for the use of La Silla facilities while constructing the Paranal Observatory is one which has received a great deal of attention by ESO. It is clear that the financial constraints on the ESO budget which is capped (except for inflation) for the foreseeable future, prevent us from maintaining all existing 15 telescopes, big and small, open to the community. ESO has therefore concentrated on the mainten-

Recording the ceremony for the completion of the first VLT 8.2 m mirror. The figure shows a photograph of the team of REOSC experts who carried out the delicate task of polishing the mirror. Also in the photograph are the directors and managers of REOSC and ESO.

ance, improvement and operation of the major telescopes while placing the smaller facilities in the hands of the national project teams. This has meant a restructuring of the La Silla Observatory in 4 dedicated telescope teams, each having responsibility for one or a few telescopes (The telescope teams are the SEST, the 3.6 m and CAT, the NTT and the 2.2 and 1-5 meter telescopes). Supporting teams for optics, detectors and engineering provide observatory wide support. The remaining 8 telescopes are being operated by national teams on a permanent or project basis.

The focusing of efforts on the major facilities on La Silla has permitted us to improve their scientific performance and to use them as testing grounds for the VLT software, hardware and operating philosophy. In particular, we have undertaken a commissioning and upgrade effort on NTT, which is now in its second year. The purpose of this effort has been to

a) bring NTT to full operational status
b) to test VLT detectors and software
c) to test new modes of science operations.

The goals of a) and b) have largely been achieved. Technical downtime has been reduced on NTT to 2 %, an almost ideal performance in a technically advanced instrument. The third phase, designed to test the end-to-end science operation model for VLT, will occur next year.

As to the future utilization of these facilities, a Working Group known as "La Silla 2000" has been created under the aegis of the ESO Science and Technology Committee which has made its recommendation for the future. The main finding of this group has been that there will be a role for smaller telescopes (2-4 meters) in the VLT era for specialized tasks that the VLT will be ill suited to carry out efficiently. This will require, however, modernization of the instrumentation and operating philosophy of these facilities.

Scientific Methodology

The purpose of ESO is to provide the astronomical community of member states with up-to-date competitive facilities in order to excell in astronomical research. While there must be, of course, always room for the unique individual contributions of particularly gifted astronomers, much of the progress in modern astronomy depends on the collection of large quantities of data and their elaboration and analysis to solve specific astrophysical problems. Modern detectors produce data at a very high rate. In the case of the Hubble Space Telescope, rates of the order of a few gigabytes per day had to be handled and stored. From VLT we can expect between 10 and 100 times more data due to the increased size of the optical detector arrays, the development of large IR arrays and the speed of readout required in active and adaptive optics applications. In order to process and store such vast volume of data, standard procedures for calibration, reduction, processing, archiving and distribution have to be developed, if the data are to be effectively used by the observer and also (later) by the community.

The development of these techniques requires the ESO staff to take responsibility for the quality of the data obtained and therefore to acquire expertise and competence in the use of at least the most commonly used instruments configurations. Calibration of instruments require in turn physical modelling of their performance, development of a calibration programme, acquisition of the data, analysis and use of the updated parameters in the calibration algorithms. These capabilities will have to be developed whether or not we use them 100 % of the time. It is currently our intention to offer the community both traditional and service observing. The tools that are being developed will be useful for both.

The role of ESO scientists

Given the above, the old debate on whether ESO should itself be a research institution or only provide service to outside observers becomes mute. The complexity of the instrumentation and operations requires the involvement of qualified scientists. These scientists can be recruited and retained by ESO only if they are given the opportunity to carry out their own research. It is the current ESO philosophy to hire scientists only if needed to carry out ESO service functions. However, they are expected to continue to remain active in research with an ideal time split of 50 / 50 between research and functional work.

From the point of view of their research endeavours they form a kind of faculty or community of astronomers within ESO. They are instrumental in maintaining and strengthening the ties to the community we serve and ensuring that our facilities are designed, maintained and operated with the objective to achieve excellence in astronomy within the available resources. To ensure that these objectives are achieved we have created a Visiting Committee of distinguished Senior Astronomers under the chairmanship of Prof. George Miley and with membership from ESO member states and other nations. This committee reviews ESO activities every two years and reports on its effectiveness to the ESO Executive and to the Council.

Relations with Chile and states not members of ESO

Of great concern in the past few years have been our relations with the Chilean Government, Chilean astronomers and Chilean staff. The main issues at hand were guaranteed access to ESO facilities by Chilean astronomers, regulations affecting the local staff and the issue of ownership of the land surrounding the Paranal peak (some 72.000 square kilometers) which had been donated to ESO by the Chilean Government in 1988.

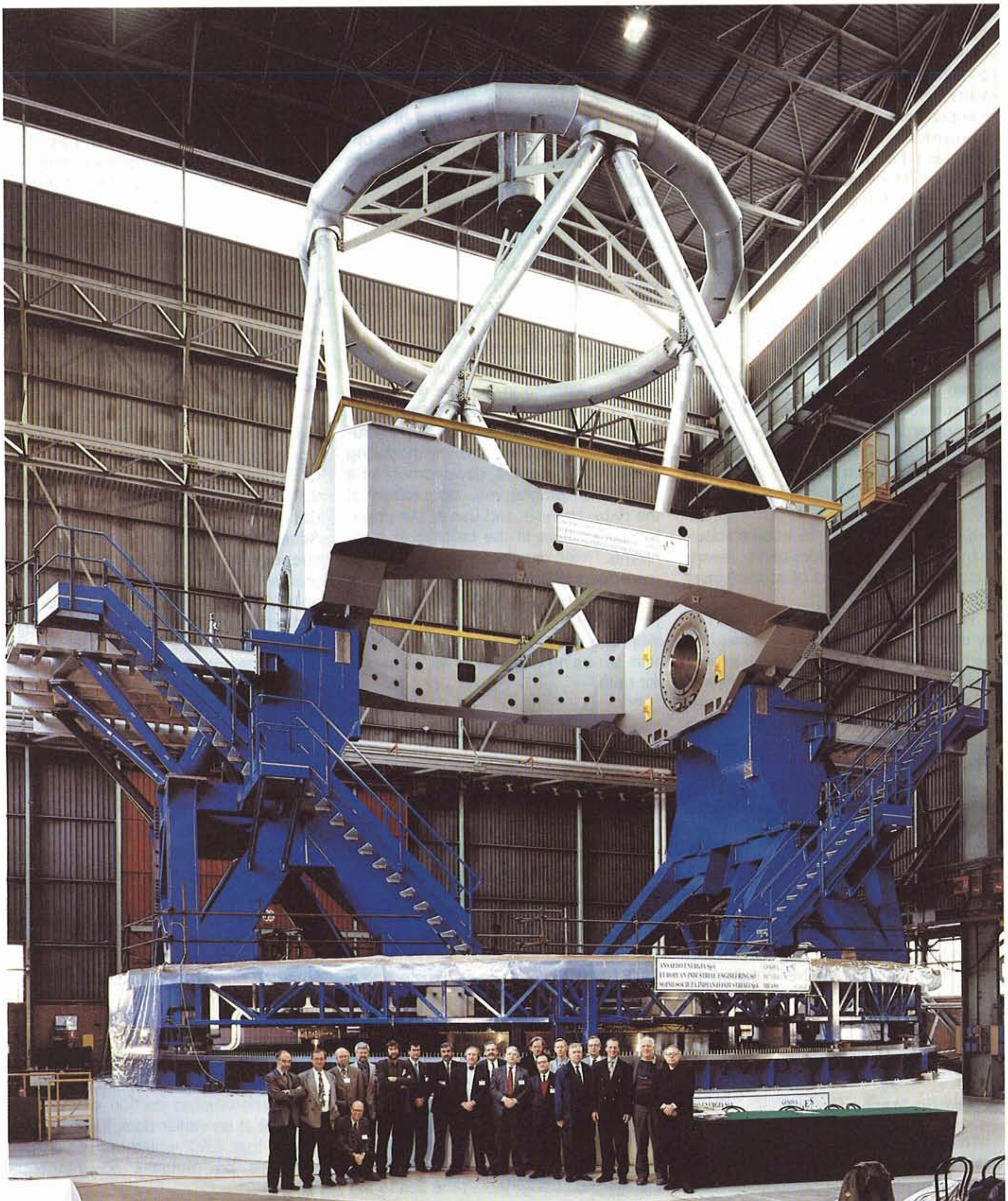
All of these issues are on the way to successful resolution. A new Acuerdo modifying and extending the 1963 Convention with the Government of Chile has been signed in April 1995 by the Director General of ESO and the Chilean Minister for Foreign Affairs. This Acuerdo foresees a greater degree of cooperation with Chilean astronomers, grants 10 % guaranteed time to meritorious Chilean projects and introduces elements of Chilean labour legislation in the local staff rules of ESO. The Acuerdo awaits ratification by the Chilean Parliament and the ESO Council which are expected in the near future. The issue of the ownership of the land has been resolved by the Chilean Government which has agreed to indemnify the claimants.

Astronomers from other European nations have expressed an interest in having their nations join ESO. Portugal has expressed a desire to join ESO in the year 2000. Currently Portuguese representatives participate as observers on all ESO committees. Discussions have taken place with astronomers from Austria, Spain and in the last year with a non-European nation, namely Australia. New members would expand the range of interests and skills brought to bear on ESO's initiatives, and their contribution would improve the opportunity to realize the interferometric portion of the programme at an earlier date. Thus it is fair to say that ESO would welcome new members on mutually advantageous terms.

ESO in the context of European Astronomy

Finally, let us consider the role ESO is carrying out at present and extrapolate to the future.

Without question the most important task facing ESO in the near future is the proper utilization of the VLT and VLTI. This implies, in my opinion, several things:



Photograph taken on 28 November 1995 showing the ESO Council members in front of the mechanical structure of one of the VLT 8.2-metre unit telescopes, now being assembled at the Ansaldo factory in Milan (Italy). The structure stands about 24 metres tall and protrudes another 5 metres below the floor. The telescope mounting consists of a blue platform which rotates on circular tracks, and a silver open structure (the „telescope tube"). When the photo was taken, the cell that supports the main telescope mirror of 8.2 metres in diameter had not yet been installed at the bottom end of that structure. The total weight of the moving parts is about 430 tonnes.

The ESO Council delegates (from left to right) are: Philippe Brossier (France), Bernard Fort (France), Bengt Gustafsson (Sweden), Johannes Andersen (kneeling, Chairman STC, Denmark), Joachim Krautter (Chairman OPC, Germany), Edwin L. van Dessel (Belgium), Stephane Berthet (Switzerland), Jean-Pierre Swings (Vice-President, Belgium), Peter Creola (President, Switzerland), Emil A.A.M. Broesterhuizen (The Netherlands), Riccardo Giacconi (ESO Director General), Dietmar Reimers (Germany), Guglielmo Castro (Italy), Poul E. Nissen (Denmark), Gerhard Bachmann (ESO Head of Administration), Gustav Tammann (Switzerland), Arno Freytag (Germany), Franco Pacini (Italy) and Francesco Bello (Observer, Portugal).

a) First a strong community of users. While the education and training of a new generation of astronomers is mainly the task of the member states, it is clear that ESO can help by furnishing opportunity for training and research to students and young postdoctoral fellows.

b) Second a commitment to support efficient operations. We have seen with NTT how important it is to properly commission and maintain sophisticated telescopes and instruments in order to obtain high scientific efficiency. We are working now to ensure that we will have a complete science verification, commissioning and maintenance programme prior to the VLT entering into operations.

c) The construction of new instruments. There are 16 possible focal plane instrument stations at the four 8 m telescopes. At the beginning 4 instruments will be completed and commissioned and 2 more will be in an advanced state of completion. If we were to provide 2 new instruments per year, the oldest instrument would be 15 years old at the building of the 16th instrument. Since ESO itself could certainly not provide more than a small fraction of this work, it is clear that much will have to be done by astronomical institutions in the member states to ensure that VLT will use front-line instruments.

d) The reduction and analysis of the data by the original observer must be made as effective as possible. ESO will support default options for calibration and reduction of the data which will guarantee a minimum set precision. ESO will also take responsibility for the archiving and distribution of the data to the community for additional research.

While the above activities will require a very considerable effort, it is also clear that attention needs be given to other sources of data on astronomical objects in a wide range of wavelengths. For this purpose we carry out a number of cooperative programmes with the European Space Agency (ESA) and the Space Telescope Science Institute (STScI).

The European Coordinating Facilities (ECF) is a joint ESA-ESO institution operated by ESO to manage the European participation in the use of the Hubble Space Telescope (HST). It has carried out its tasks with a high level of expertise which has resulted for instance in a joint successful development with STScI of the HST archival system. This expertise has been placed at the disposal of ESA to support other ESA missions such as ISO and will be fully utilized on VLT. ECF scientists have taken the lead in the scientific proposals for future ESA instruments for HST. It is possible that more extended ESA-ESO cooperative programmes could be undertaken in the future.

In a general way the collaboration between ground based and space observatories should be seen in the light of a modern view of astrophysical research in which the boundaries between specific wavelength domains or techniques are becoming irrelevant to the pursuit of astrophysical knowledge. For instance, there is a great deal of interest in the astrophysical community for the study of the large number of objects which have been or will be discovered from space missions, such as Rosat, ISO, XMM, etc.

In these collaborations ESO's strength resides in its ability to interpret and represent the scientific requirements of the community and to ensure the maximum scientific utilization of the data.

Upon successful completion of the VLT and VLTI, ESO will have developed the managerial, engineering and contractual capability needed to carry out large astronomical programmes in remote locations. Such capability will be unique in Europe. While the main task for the future will be the proper exploitation of VLT and VLTI, we expect that resources will also become available to undertake new major projects that may be advocated by the astronomical community. ESO will strive to continue to provide service to the community with excellence in astronomy as its goal.

TELESCOPES AND INSTRUMENTATION

The VLT Sequencer[1]

E. ALLAERT, ESO

Introduction

Software designed to control extremely complex equipment like the VLT is unavoidably itself also pretty complex. It contains impressive quantities of procedures, programs, libraries and other sorts of files. And even if from the very beginning a lot of attention is paid to the requirements of flexibility – with all these different instruments – it is difficult to foresee and manage all the possible combinations within monolithic executable programs. And if you want to add a feature to a program or change its behaviour, you have to edit its source code, compile it, link it with the necessary libraries and launch it again (many times just to see that the wrong line of code was modified). This is obviously a time-consuming exercise. Moreover, on top of a solid programming experience, also a profound knowledge of the VLT software structure is required to do that.

Specific user interfaces, which guide the users through the preparation and execution of their observations, already ease the pain offering some flexibility, as they allow the users to choose between various alternatives or to fill out specific values in forms. Still, this approach has its limitations, as changing such a graphical user interface (*GUI*) itself to e.g. add another parameter is again not trivial.

That means there is a real need for more and better tools to glue the basic commands and applications together, offering an easy means to control the VLT and its instruments at a higher level.

The Sequencer

Looking at how any telescope and instrument are operated, it is obvious that many commands are repeated in a certain sequence, sometimes with only slightly different values for the arguments. From an operational point of view, users differ one from the other as each of them repeats his own set of sequential commands. From this fact, the concept of Sequences was defined for the VLT control software; they are any

[1]This is part of a series of regular reports on VLT Control Software, started with issue number 81 of the Messenger (Raffi 1995)

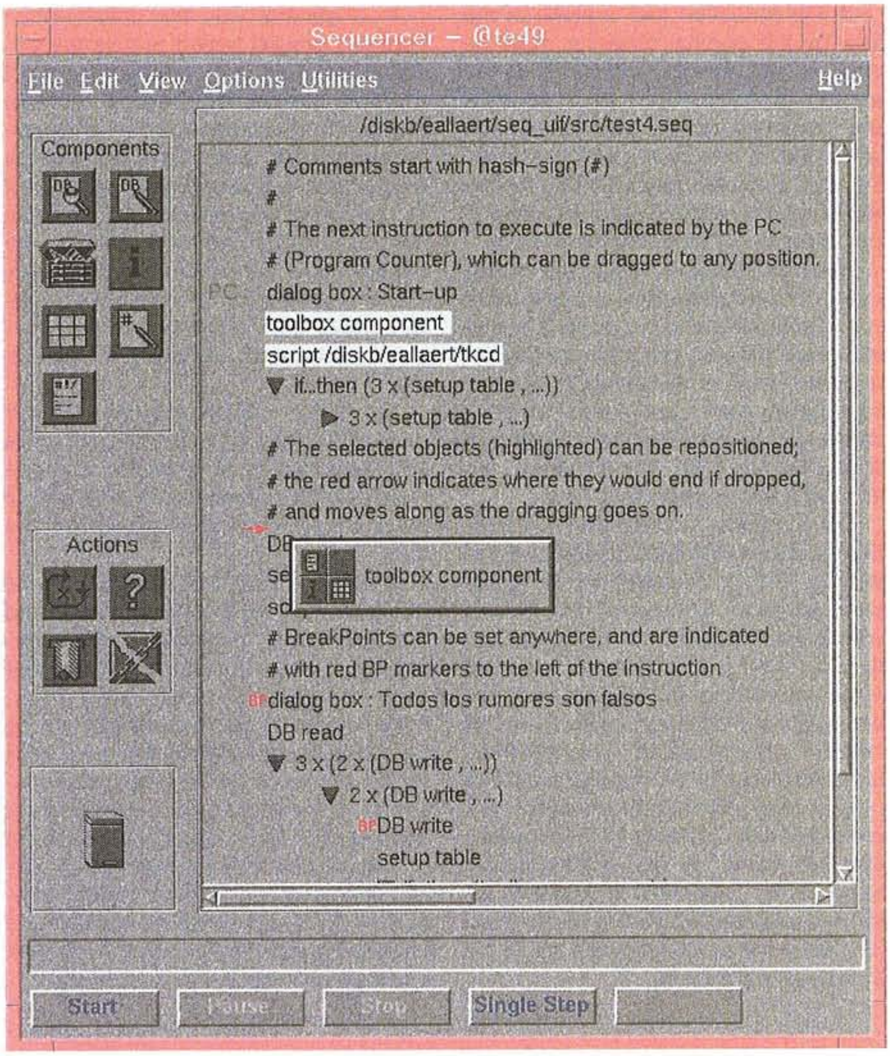


Figure 1: *A snapshot of the Sequencer's prototype GUI.*

combination of known commands. They can contain instructions controlling the flow of execution, offering a great deal of flexibility and intelligence. Remark that this definition covers a very broad range of cases. E.g. a set of low-level commands dealing with part of the execution of a single exposure can be grouped together as a sequence, which then can be considered a high-level command. On the other hand also the combination of several exposures can be a sequence, as only a few high-level commands are needed to execute a single exposure.

The *Sequencer* is the engine around the concept of these sequences. Depending on the level of programming awareness and interest of its users, we can subdivide this product into two distinct components:

1. a scripting language, which allows developers and operators to glue their commands and procedures quickly and efficiently together. The purpose may be either to implement high-level functionality or to to create complex utilities, including GUIs. These scripts generally relieve users from repetitive tasks and manual intervention.
2. a tool to assist astronomers in the preparation and execution of sequences of commands and observations. A primordial aspect of this tool is its user-friendliness: it must be very intuitive to use, and should avoid to expose its users to the complexity of the underlying software components, scripting language, etc.

The Scripting Language

The Sequencer's scripting language is based on a free software package, namely Tcl/Tk (Ousterhout 1994, Welch 1995) Tcl stands for "Tool command language"; it is a simple programming language, while *Tk* provides an X11 ToolKit or library of widgets (graphical objects similar to those of other GUI toolkits like Xlib or Motif). This permits us to make windowing applications as simple scripts, hiding many of the details faced by C programmers. These scripts are interpreted by a shell built around the Tcl/Tk library.

Tcl was chosen as the scripting language for the VLT Sequencer as many of its features could be mapped into our requirements. Also, since its conception it has enjoyed a very good acceptance in the scientific and astronomical community, and has in the meantime an impressive user base.

One of Tcl's nice features is its extensibility, i.e. it is relatively easy to add more commands to the core. Of course this is something most specific applications based on Tcl have to do, and the VLT Sequencer shells are no exception to that. The resulting interpreter incorporates a number of extensions, including our own 35 or so commands to interface the VLT Central Control Software (a set of common services like database access and message system – see Raffi, 1995). It contains all necessary flow control commands to allow sequences to behave intelligently. However, it is certainly not our intention to map every procedure call available in the VLT C-libraries into a corresponding script-command. Bear in mind that the purpose of the Sequencer is to provide some *glue*; it is not meant as a substitute for C-programming. Sequencer scripts are interpreted, so they can never run as fast as equivalent C programs.

A number of VLT applications have already been built using this scripting language. The most complex and notorious application of this kind is at present the Panel Editor. This is a tool to graphically create panels which conform to the *ESO GUI Common Conventions*. Other applications are several engineering interfaces, e.g. to configure or diagnose motors.

The Sequencer Tool

The Sequencer Tool itself, presently in a prototype status (see Figure 1), is also programmed in the Sequencer scripting language. The goal is to permit simple visual programming of sequences.

These are composed of fundamental building blocks (*components*), on which control flow *actions* can be performed. The use of the Panel Editor provides a look-and-feel similar to other VLT applications, in areas like menus, short-help text, etc. Drag-and-drop functionality and other features aim at making this tool even more intuitive.

Looking back at how this tool is made and what it produces we see an interesting closed loop: the tool creates scripts in the same language with which it was made in the first place. The fact that part of the Sequencer Tool was made with the Panel Editor – also a script producing scripts – seems to make it even more self-contained.

What's in the labs

The Sequencer interpreter is based on the Tcl/Tk core as explained in 3. The versions we use are 7.3 for Tcl and 3.6 for Tk. On top of these the Sequencer interpreter includes currently the following extensions:

1. *Extended Tcl/Tk*: this extension adds several commands useful in a Unix context; its version has to match the one of Tcl/Tk, as it patches this core.
2. *BLT*: the Bell Labs Toolkit adds a few commands to the Tk library. Presently at version 1.7.
3. *[incr Tcl]* or *iTcl*: this extension provides an object oriented programming environment in Tcl/Tk, which allows and promotes organisation of the scripting code in a much cleaner way than plain Tcl does. iTcl is at version 1.5.

A few months ago new versions of Tcl and Tk were released (7.4 resp. 4.0), which provide more functionality, better Motif compliance and tons of other modifications and improvements. Of course the Sequencer interpreter will be updated to these new releases of Tcl/Tk, but we also need matching versions of all the extensions included in our interpreter. In particular we are waiting for the 2.0 version of iTcl[2], which should bring a major performance improvement as a bonus. That should manifest itself a.o. in all applications created with the Panel Editor.

Once we have the needed extensions, we will still have to address the compatibility issues: several VLT applications have been implemented as Sequencer scripts, and they may be affected by modifications in Tk's behaviour or syntax.

We expect to have this update for the Sequencer interpreter ready for internal use early 1996, and to release it externally with the next subsequent VLT Common Software Release.

References

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Raffi G., 1995, *The Messenger* **81**, 5.

Welch B., 1995, *Practical Programming in Tcl and Tk*, ISBN 0-13-182007-9.

[2][incr Tcl] version 2.0 should be available by the time you read this.

The VLT CCD Detectors Control Software[1]

A. LONGINOTTI, C. CUMANI, P. DUHOUX, ESO

Introduction

Charge Coupled Devices (CCD) are currently by far the most widely used type of detectors in Astronomy. It is foreseen to have in operation at the VLT about 40 technical CCD cameras for auto-guiding, field viewing and wavefront sensing, and probably more than 10 scientific CCD cameras for instruments working in the optical spectral range. Because of the critical role it plays, it has been decided that the CCD Software Package should be the very first VLT application to be built and tested on top of the VLT Common Software. Because of that, the CCD Software has provided, together with the NTT upgrade software, a considerable feedback to the VLT common software in terms of bug detection and suggestions for improvements.

It has also been decided to put in the development life-cycle a prototype stage, to allow a better evaluation of the validity of the whole camera concept, including, of course, its control software. A field test has been successfully performed January 1995; from that time efforts have been concentrated in adding functionality and bringing the whole package to VLT standards, both in terms of software quality (quality of code, documentation, configuration control) and of general rules applicable to all VLT software applications (usage of standard commands, libraries, etc.).

The first release of the CCD Control Software, originally planned for August 1995, has been recently sent out (October 1995). It contains a sub-set of the foreseen functionality, and does not support technical CCD cameras yet (this will be done with the next release). On the other hand, it defines the complete interface towards external software.

Baseline development criteria

The development of the CCD Control Software has been based on the following criteria:

- It must fit in the general VLT control architecture (distributed system consisting of Workstations, for high level operations and user interface, and Local Control Units, for real-time and sub-system hardware related operations). For more information, see the article of G. Raffi about the VLT control software in the Messenger, issue September 1995.
- It must use, wherever possible and compatible with the performance requirements, components provided by the VLT common software.
- It must provide a programmatic interface to all packages (instruments and telescope control software) using CCD cameras, but also be able to work as a stand-alone simple instrument, mainly for test purposes.
- It must interface with the already defined and developed transputer-based CCD controller box, also called Array Control Electronics (ACE).
- CCDs being a technological area in very rapid progress (bigger and faster chips are continuously coming up on the market), it must have an interface to the hardware as flexible as possible, in order to accommodate possible upgrades of the ACE-based or totally new CCD controllers, keeping the bulk of this package independent from the particular controller used.
- In order to simplify its maintenance, the CCD software must be one package, providing the functionality required for both technical and scientific cameras. Differences in the control software between these two categories must reflect only the differences in

[1]*This article is part of a series of regular reports on VLT Control Software, which started with the previous issue of the Messenger. (Raffi 1995)*

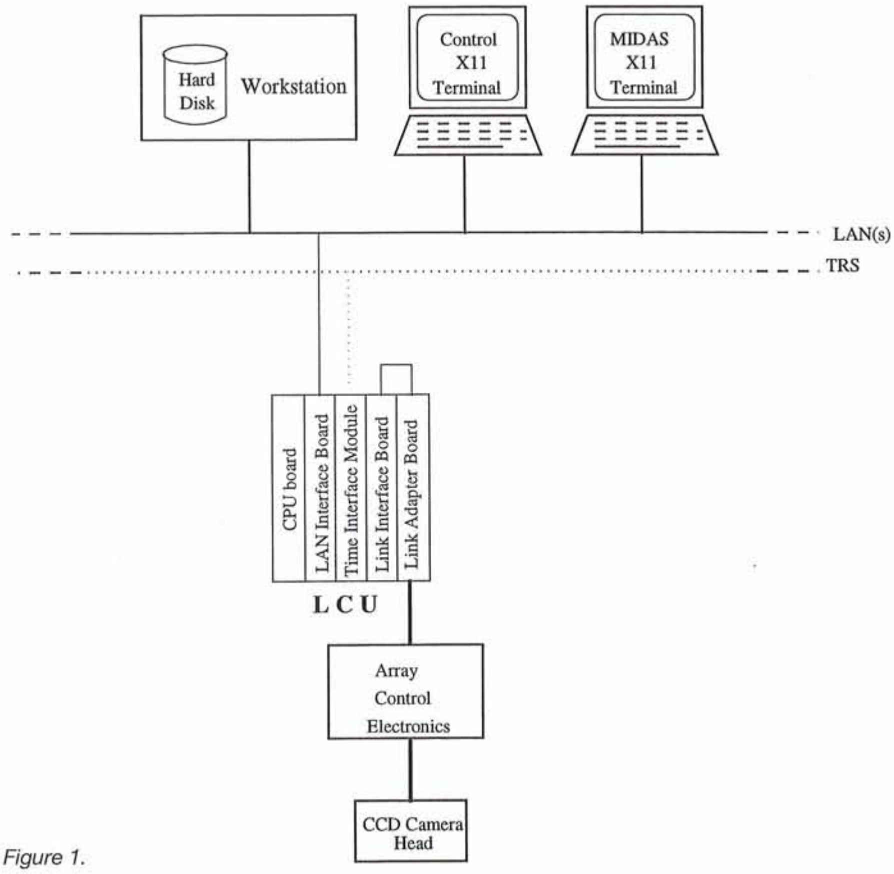


Figure 1.

the control electronics, and therefore be confined within ACE.
- The ACE transputer and DSP software for technical CCDs being developed by an external contractor, much attention and emphasis has to be put on the specification and implementation of the LCU-transputer interface.

Architecture

The current version of the CCD software runs on three platforms:
- Workstation, where both programmatic and interactive user interface are located. The language used is C, whereby Tcl/Tk scripts are used within GUI panels.
- LCU, where the core of the control is implemented. It has been designed to simplify as much as possible the adaptation to other controllers. About 80% of the whole software is independent from the particular controller connected to the LCU VME crate. Basically one function library, called Device Control Library, provides the interface to ACE, and only this component must be replaced if a different type of controller is used. The language used is C.
- ACE, where the transputer and DSP based embedded software runs. It provides the direct interface to the camera electronics. The languages used are Occam (transputers) and C (DSP).

A schematic view of the architecture of a CCD stand-alone system is provided in figure 1.

Functionality

The main functionality provided by the CCD software is:
- Single exposure execution (possibly repeated n times), with selectable readout parameters: binning, windowing, speed, gain, outputs used.
- Images are provided both as FITS files and as raw data, for quick look through the VLT Real-Time Display facility.
- A real-time image processing facility on LCU is foreseen, to fulfill the requirements for technical CCDs (centroiding calculation, object recognition). This functionality is not implemented yet.
- A telemetry information system is foreseen, but not implemented yet.
- A temperature control system is foreseen, but not implemented yet.
- Besides the normal operational mode, simulation operational modes are provided, at all stages of the control architecture, in order to allow the integration and tests of this package in environments where the hardware needed is not fully available:
  - WS simulation. The whole LCU software is simulated on Workstation
  - LCU simulation. The ACE software is simulated on LCU.
  - ACE simulation. The hardware access is simulated in the transputer software

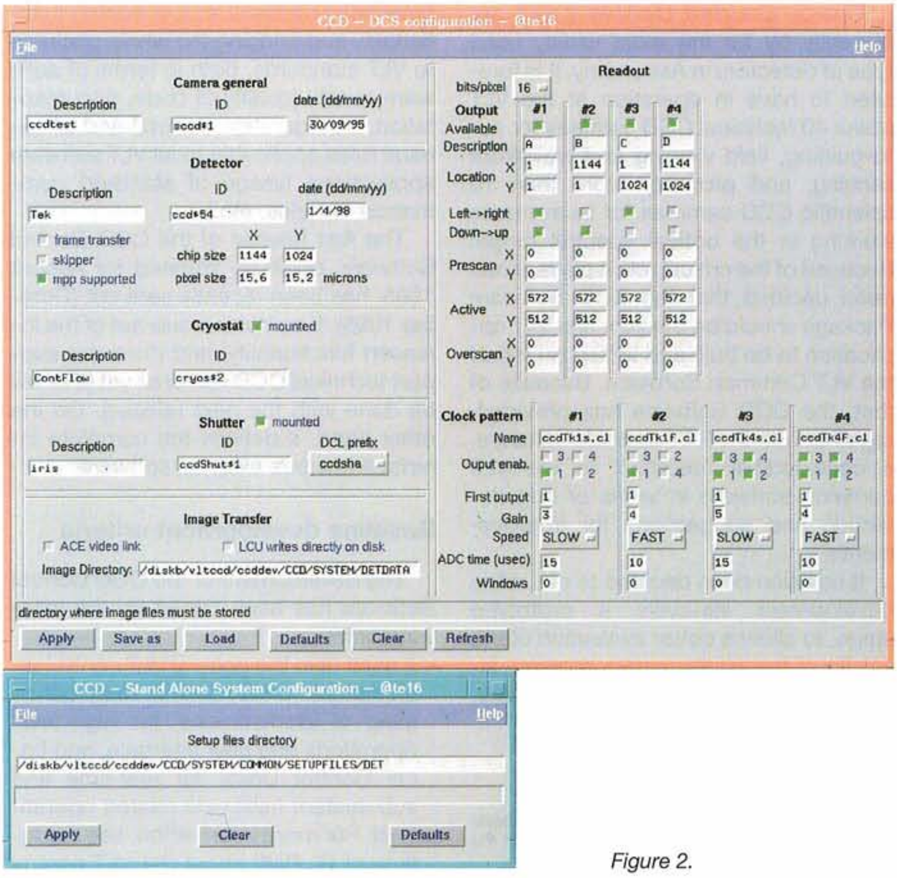


Figure 2.

Figure 3.

Usage by external software packages

A general software development criterion, which we tried to apply also to the CCD Software, is to make the interface to external software as simple as possible, using as much as possible standard components. The interface to external software consists of:

- Command/Replies, based on the VLT Software Message System, to/from one CCD Command Interface process, running on Workstation. All actions associated with an exposure, including the definition of the exposure setup, are performed through commands.
- Data. They are basically of four types:
  - Camera configuration data. They are stored in the on-line database and can be retrieved through a public function provided by the CCD software. In order to simplify the operation of setting the configuration values for a specific camera (this operation is done normally by people familiar with CCD cameras, but NOT with software), one configuration GUI panel is provided (see Figure 2).
  - Exposure setup parameters. They are stored in ASCII files, called setup files, as specified by the Instrumentation Common Software.
  - Image Data. They are delivered by the CCD software as FITS files, to be used later for further analysis by any image analysis package, and/or, according to the setup definition, as raw data in shared memory for quick look through the VLT Real-Time Display facility (see also article by T. Herlin et al. in the September 1995 issue of the Messenger).
  - Real-time image processing results. They are used mainly by applications using technical CCDs, such as autoguiding software. For performance reasons, they are stored directly in the LCU on-line database.

Usage as stand-alone instrument

As already mentioned before, the CCD Software must be able to work as simple stand-alone instrument. It must therefore implement on Workstation a simplified version of those modules foreseen for any VLT Instrument: Observation Software (OS), Observer Support Software (OSS), Maintenance Software (MS). The current release provides a set of panels to allow the following (see also Figure 3):

- startup/shutdown the system
- define a single exposure setup and save it in a setup file
- start an exposure, monitor its status, possibly pause or abort it.
- display the results (image) with the VLT Real-time Image Display facility.

Foreseen, but not implemented yet, are:

- interface to on-line Midas.
- definition of sequence of exposures and automatic execution (useful for

standard calibration operations, such as linearity tests).
- interface to VLT Archive.

Acknowledgments

The authors would like to take this opportunity to thank all people who helped in the development of the VLT CCD Control Software up to the current stage:

- Norbert Fiebig, consultant, who implemented the LCU part of the CCD software for the prototype version.
- all members of the VLT Software Group, for their collaboration in assisting us in their area of competence.
- all members of the newly formed Optical Detector Team, for their valuable contribution in terms of comments to the prototype version.

For more information or questions on the VLT CCD Control Software, please contact, preferably by e-mail, A. Longinotti (alongino@eso.org). Additional information can also be found in the anonymous ftp area of the VLT Software Group, which is accessible via WWW (Eso Home page -> VLTProject -> VLT Software and Documentation -> doc -> ccd*)

Restructuring La Silla

D. HOFSTADT, ESO

During the past months the La Silla staff which is closely involved with the telescope activities has been asked to reflect on ways to re-organise the Observatory operations.

La Silla has a long tradition of extensive and user-friendly support and enjoys a large record of praise from its visitors.

If it works, why change it?

There are essentially three main factors which call for a change:

1. The VLT operation era is nearing. We have still an opportunity to try out different and more ambitious operation modes at La Silla and let the VLT benefit from the experience.
2. The budgetary pressure has become stronger and stronger. Cost control has been emphatically requested by our Governing Bodies. Cost efficient priorities have to be worked out and implemented.
3. The number of facilities and services, under ESO's direct supervision at La Silla, has decreased.
   This calls for a re-assignment of the staffing resources at the Observatory.

It is tempting to breakdown the La Silla operations into Telescope Teams. Undoubtedly, great benefit is to be obtained if the teams and their telescope merge into a common identification.

This has been achieved at SEST since it was brought into operations. Also at the NTT, D. Baade and his colleagues managed to build-up a team well integrated and identified with its telescope.

The Change

It was decided to create two additional teams for the support of the remaining telescopes:
- one for the 3.6m/CAT
- one for the 2.2m/1.54m/1.52m.

The Schmidt, the 1m, the 50 cm Danish and the Bochum telescope already have separate operational arrangements.

For the time being the Dutch and 50cm ESO telescopes would receive technical support from the 2.2 m/1.5 m team.

J. Melnick took on the task of crystallising and elaborating a plan for the restructuring, which he called the "Team Theme".

Much input was provided by the scientific and technical staff at La Silla.

The Team Theme was developed in a number of working groups. All of them focused on the self managed team concept organised around a functional process.

Integrated by astronomers, night assistants, operation and electronic staff, the telescope teams are to be self-reliant for the daily support. This includes scientific support, instrumentation setup and control, data management and the first aid technical assistance.

In general the welfare of a particular facility will be exclusively in the hands of a team.

The teams will also handle their internal administration for tasks and personnel scheduling, planning, reporting and training. They will ensure the operational interface with their visitors.

The teams are also to be linked with Garching for extended technical support and commitments.

In view of the large range of work and the limited manpower it was not feasible to provide for complete technical autonomy in each team.

Six technical sections are maintained and regrouped as support teams in the areas of software, general electronics, mechanics, optics, IR detectors and optical detectors.

They will provide the specialised skills, maintain units which are common to all the telescopes (e.g. CCD cameras) and execute long term upgrade projects.

Both the telescope and support teams have similar structures.

The intent is to have each team with extensive freedom of self-management. Each team has a manager assisted by a deputy. Their role is to plan and manage the resources, schedule operational and technical tasks, monitor and report the performance of the team. The managers, however, are an integral part of the support and not limited to supervisory functions. They report to the Observatory management composed of a Director and his deputy.

The Observatory management is essentially responsible for the application of the scientific objectives.

It defines the goals and objectives, harmonizes the structures, policies and operational procedures for the teams and ensures a smooth interface and integration with the other divisions, both in Europe and in Chile.

In parallel with the merging of the Astronomy and TRS Departments into a common project, the Maintenance and Construction Department has undergone changes.

Here the objective was extensively focused on cost efficiency. As the host country Chile has considerably developed during the last few years, many services, which ESO operated internally, became available at much lower costs. Maintenance for the buildings, roads and power lines, has been outsourced. The plan is to keep a limited in-house support for emergencies and the maintenance of electro-mechanical equipment, which is highly diversified.

Will it work?

The re-engineering experts would propose a strength-weakness-opportunity-threat analysis.

• *Strength* – The new scheme will focus the involvement of the team members on smaller targets and allow for the development of skills and knowledge in a more limited field of action. Improvement of performance is expected. There will be better visibility for each team member on the complete field of action inside the team. A better complementation and multi-disciplinary task approach can be developed.

The scheme allows for better identification with the team objectives and promotes team spirit.

• *Weakness* – Full support coverage around the year is difficult to achieve in view of the limited manpower.

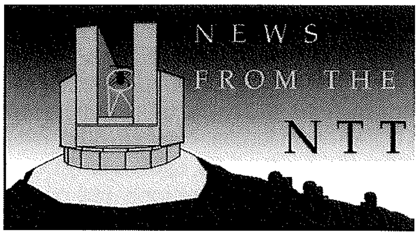
• *Opportunity* – There will be an opportunity to integrate and extend the complete operations chain at a telescope within a dedicated working unit. For the team members there will be an excellent opportunity to demonstrate a competitive and high performance style of operations.

• *Threat* – The task division between the teams will limit the possibility of inter-team back-up once the know-how for the operations in neighbouring teams fades.

A broad consensus emerged on the "Team Theme" among the staff and the management. End of August during his visit to Chile the Director General reviewed the proposal and gave his go-ahead.

October 1st we started.

We will now demonstrate that we were right.



JASON SPYROMILIO

The NTT upgrade project has the following goals:

1. *Establish a robust operating procedure for the telescope to minimize down time and maximize the scientific output.*
2. *Test the VLT control system in real operations prior to installation on UT1.*
3. *Test the VLT operations scheme and the data flow from proposal preparation to final product.*

The project is a joint effort of all divisions within ESO both in Chile and in Garching. At the core of the project is the NTT team which is doing much of the development and almost the totality of operations.

The NTT upgrade project is not only providing ESO the means to test the VLT concepts but also the community a first taste at what working with the VLT will be like. Both ESO and the community should exploit this unique opportunity to make possible a VLT that is scientifically productive as soon as possible.

The NTT upgrade project with great sadness bids farewell to Dietrich Baade. Dietrich was NTT team leader and upgrade scientist from the inception of the project. Dietrich has been instrumental in developing the team spirit within the NTT and the operating procedures which have resulted in the NTT having amongst the lowest down time statistics of any 4-m class telescope. Dietrich has through his dedication, hard work and inspiring personality united the two parts of the ESO organization (La Silla and Garching) into working as a single team and has got the project well under way. Thank you Dietrich.

The author is the new team leader and upgrade scientist. Given the change in leadership for the project it is appropriate to take stock of where we are and how far we have to go. As mentioned above the NTT is on solid ground regarding day to day (night to night) operations. So the first goal of the project has indeed already been achieved. In addition over the last year a number of VLT standard components have been tested on the NTT with great success. Part of the second goal of the project, to test the VLT control software, has already been achieved with a large amount of feedback from the NTT project to the VLT.

The Big Bang

In July 1996 the NTT will be taken out of operation to install a completely new control system. The new system is in fact almost identical to that to be used on Unit Telescope 1 of the VLT. In addition new control software is being written according to VLT standards for EMMI and SUSI. The installation and testing of these systems is a large effort involving not only modifications to the telescope control but also the building, the rotators and the guide probes. In addition the autoguider will also be equipped with VLT standard Technical CCDs. All electronic local controllers will be modified to allow the use of the more advanced software developed for the VLT. In addition many maintenance operations are scheduled for the big bang period including the long overdue recoating of the mirrors. The NTT team plans to come out of the big bang period with what essentially will be unit telescope 5 of the VLT.

Progress with Big Bang preparations

Each subsystem of TCS is being tested on the NTT independently. The existing electronics is modified and then the subsystem is run through a commissioning phase to check its operability. Following the tests the system is returned to its current stable configuration. The NTT team has successfully tested the building, M2/M3, autoguider and adapter control subsystems. The rotator control system will be tested in November and in December we expect a full test of the telescope. This December test is scheduled ahead of the Milano test of the same software for the VLT in order to provide the best feedback. The EMMI control software will undergo its first test in February.

Phase III

The NTT will be returned to active duty for the community as soon as possible. After the big bang, which barring unforseen problems will last around 6 to 7 months, the VLT science operations scheme shall be tested in real operations with the community providing the critical feedback to ESO. The details of the VLT operations scheme fill more than 70 pages so it is not possible to go into it at length here. The fundamental principle is that operations shall be predictable and reproducible. Given this starting principle we believe that it is possible for the users of the NTT to define their observations in an accurate enough manner that it shall be possible for the NTT team to execute these observations. The benefit to the community if such a scheme is successful is tremendous. One of the most obvious benefits is that observations shall be scheduled exactly when the conditions are best suited for them. During the first months following the big bang service observations shall be interleaved with system test phases. In normal operations we do not plan that all observations will be performed by the NTT team. Clearly some significant fraction of all observations on the NTT are sufficiently specialised that the principal investigator should be present when they are being executed. The exact ratio of service observations to classical observations is not specified and will, we believe, be determined by market forces.

The immediate future

At the time this article is published the big bang will be only 6 months away. The NTT team has a lot of work ahead of it both in building the new control system and in working on the tools necessary for the new operations scheme. Detailed calibration databases are being established for EMMI and SUSI. Reliable and accurate physical models of the instruments are being used to provide a good understanding of how the NTT really works. The combination of these activities is planned to culminate in good tools that make it possible to accurately define the observations.

As mentioned in previous issues of the Messenger the communications between the users and the telescope team are being facilitated using the ntt@eso.org email account. Information about the telescope and the instrumentation is now maintained on the Web for easy access. Check us out on http://www.eso.org/NTT/

Automated data reduction tools are being developed within ESO to receive the data coming from the instruments. The NTT data have been kept (archived) for many years now. However the goal of the archiving system is not simply to keep the data but to make them useful. Significant effort is being dedicated to make the archive into a scientifically useful tool.

Comings and goings

The restructuring of La Silla has resulted in the departure of Jesper Strom from the NTT team. As a founding member of the team he will be sorely missed. Congratulations Jesper on your new job as 2.2-m team leader. New arrivals in the NTT team are Paul Le Saux and Joaquin Perez from the operations and optics groups in La Silla and Karen Mueller in Garching. Welcome to all.

jspyromi@eso.org

ADDITIONAL NEWS FROM THE LA SILLA SITE

The La Silla News Page

The editors of the La Silla News Page would like to welcome readers of the Messenger to the second edition of a page devoted to reporting on technical updates and observational achievements at La Silla. We would like this page to inform the astronomical community of changes made to telescopes, instruments, operations, and of instrumental performances that cannot be reported conveniently elsewhere. Contributions and inquiries to this page from the community are most welcome. (P. Bouchet, R. Gredel, C. Lidman)

News From The Telescope Teams

The recently formed 3.6m + CAT and 2.2m + 1.5^2 Telescope Teams are glad to inform Users that accounts have been created at La Silla and Garching for general user support. These accounts will be checked daily by the Telescope Team coordinators, ensuring a more prompt interaction between ESO Users and Telescope Teams.

3.6m + CAT:

The account 360cats@eso.org has been created to enable ESO observers to provide both set-up requests and feedback of their observations. Observers are kindly invited to use this facility. In the case of special requests, we would like to have your input well before the beginning of your observing run. The account in Garching (360cats@eso.org) is mostly meant for assistance with proposal definition and data reduction. In addition, the 3.6m + CAT weekly reports can be accessed by typing 3p6wkrp nn, where nn is the number of the required week, from any account on the La Silla off-line system. The weekly reports can be retrieved as postscript files via ftp from lw5.ls.eso.org (username: ftp; password: userid; directory: pub/360cat). Via netscape, the reports are available using the option open location with address ftp.//lw5.ls.eso.org/pub/360cat.

2.2m + $1.5m^2$:

The account 2p2team@ls.eso.org has been implemented at La Silla. This account is meant to serve as a contact point for all problems, questions and requests related to the ESO-MPI 2.2m, the Danish 1.54m and the ESO 1.52m telescopes. Support will also be available for the Dutch 90cm and the ESO 50cm telescopes. In the future it is foreseen to implement automatic forwarding to this account from the WWW ESO pages.

The Quality of the 3.6m main mirror

A. GILLIOTTE

With this note, a brief history of the 3.6m main mirror is given, together with a summary of the actions that have been and will be taken to better understand the problems affecting this unit.

The 3.6m main mirror is made with cemented hexagons of fused silica. On top of these hexagons, a layer of silica is deposited. During the first polishing phase, this layer had to be re-manufactured because it was originally too thin. Early after the installation of the mirror at the telescope, during 1976, a few "white frosted stains" were noticed on the main mirror surface. The evolution of these surface defects has been analysed during each aluminisation. Over the last ten years, the mirror was aluminised during 1985, 1988, 1990 and 1994... During the 1985 aluminisation, recording of the surface defects started, by producing manual maps of the surface. This recording can be done only during the aluminisation period because the fresh aluminium and the absence of dust allows a precise recognition of the surface structures.

This operation was refined during the following 1988 aluminisation with a mapping done under stronger illumination. With this technique, all kinds of defects such as scratches, cleaning stains, aluminium projections and "frosted zones" can be well resolved and mapped in detail. Following the results of this first detailed mapping, attempts were made to contact the main mirror manufacturing company in 1989, unfortunately, with no success. The same procedure was applied (under the same conditions) after 1988 and the evolution of the defects was described in the aluminisation reports of 1988, 1990 and 1994.

In Figures 1 and 2, the maps of the 3.6m main mirror, as recorded in 1988 and 1994, are presented. The comparison between these maps show the evolution of the blemishes in the last 6 years. During these years some new frosted zones close to the mirror center, affecting less than 0.2 percent of the mirror area, appeared. Please note that, due to the manual design of the maps, the maps give a picture which appears worse than in reality. This is due to the fact that all the defects are drawn with the same intensity, regardless of their true effect. Figure 3 shows a picture of a

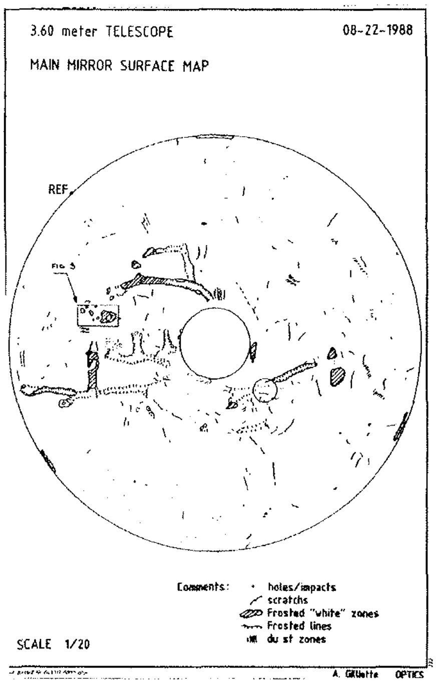


Figure 1.

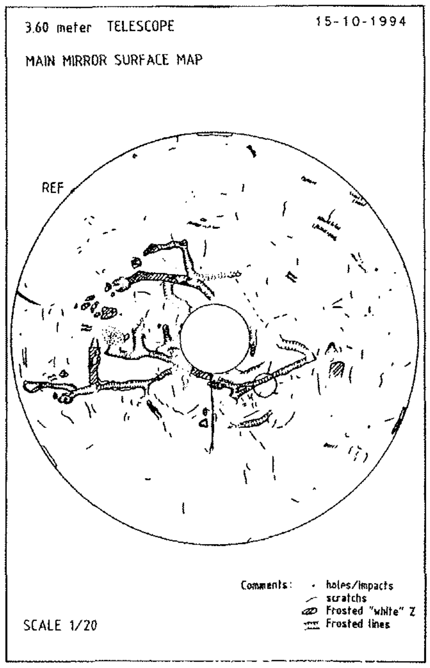


Figure 2.

small affected area (also indicated in Figure 1) with a frosted zone and spots, which appear as white regions. The size of the larger frosted stain is 70mm. Despite the low contribution of these defects to the overall telescope efficiency (see below), it was decided to establish a diagnostic of the mirror "illness", in the framework of the 3.6m + CAT Upgrade Plan.

During the last aluminisation qualification of the frosted zones began, using both magnified surface images and the measured reflectivity of the affected areas. In Figure 4, the transition area between a frosted spot and a sound zone is shown. The spot appears in black and the magnification of the picture is 135, giving a spot diameter of about 0.5mm. A grain structure is easily visible, with a grain size of about 3 microns.

How do these defects affect observations?

After a fresh aluminisation the reflectivity at 670nm varies from 89% for for sound areas to 82% for the frosted ones. The rugosity (a measure of the roughness), which is 15Å for an excellent mirror, varies from 60Å in good zone to 140Å in an affected one. Dust on the mirror produces a similar roughness of about 120Å. The zones affected by the defects cover only 2% of the whole mirror surface. The contribution of the defects on the overall telescope efficiency is negligible, in comparison to that produced by dust.

IR observers may be concerned by the influence of the surface blemishes on emissivity. Emissivity is regularly monitored at 10μm, and no enhancement has been recorded in the last few years. In fact the measurements show a decreasing trend of emissivity with time, probably due to the CO_2 cleaning procedures that were adopted in the last few years. This shows that emissivity is largely dominated by dust.

Future Steps

Contacts have been successfully re-established with both the manufacturing and polishing companies. It was found

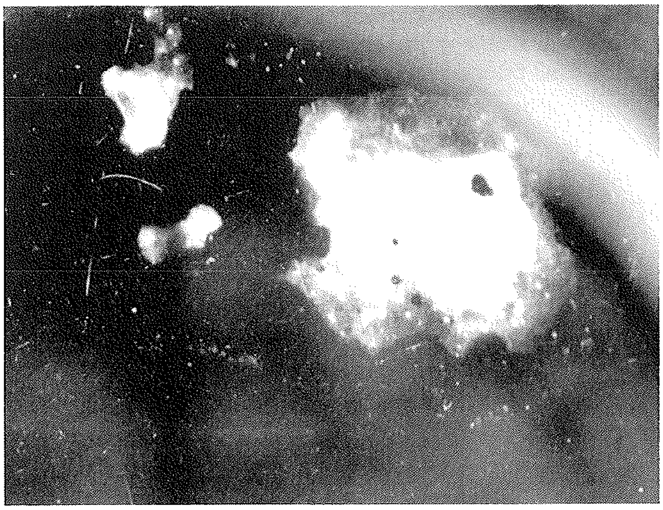


Figure 3.

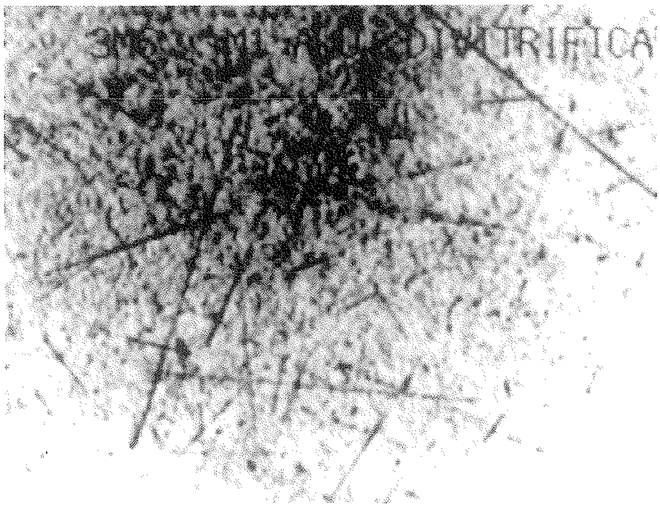


Figure 4.

that no other mirrors having the same characteristics as the 3.6 m main are in use. This implies that no direct comparison can be performed. In addition, it has emerged that, due to the manufacturing and polishing history of the mirror, some parts it may be sensitive to particular chemicals.

The next aluminisation of the 3.6m main mirror is anticipated during June 1996. The frosted areas will be analyzed with higher precision. Specific instrumentation will be used to characterise the degradation process:

- A phase contrast microscope will be provided by REOSC and used to figure out the depth of the defects. This instrument is also used to characterise the VLT mirror surface quality.
- An Atomic Scale Tribometer will be also used to map precisely the surface with a very high resolution.
- Surface images with a magnification of 270 will help detail the grain structure.
- Following the results of these tests a small sample of one of the affected zones will be sent for a chemical analysis. A sample from the mirror bottom has been already analyzed and it will be used for comparison. The results show that the sample is almost pure silica with only 0.1 % in an amorphous phase.

Even if the slow evolution of the 3.6 m main mirror defects does not suggest a dramatic impact on telescope performance in the coming years, in order to obtain full control of telescope quality, the degradation process must be understood.

The Aluminisation of the Main Mirrors

The La Silla Optics Support Team

During period 55, the main mirrors of the 1.5 m, 1 m, CAT, 90 cm Dutch and 1.54 m Danish telescopes were successfully aluminised. The reflectivity of the fresh aluminium was measured to be around 90% at 670 nm. A surface quality study was initiated to determine the evolution of the mirror surface quality. Magnified images and rugosity measurements of the surface have been obtained for each mirror. The rugosity ranges from 15 Å for the best mirror to 40 Å for the poorest. Dust will, after one year, increase this number to around 120 Å producing both light diffusion and an increase in the emissivity.

The aluminisations were performed with the small aluminisation plant located within the 1.5 m telescope building. This plant was refurbished completely by La Silla staff to solve the poor adherence of the aluminium layer. A LN_2 trap was added between the chamber and the oil diffusion pump to stop the oil backstreaming towards the aluminising chamber. The glow discharge cathode was also modified to increase the size of the plasma within the chamber. The good adherence of the aluminium has met the objectives of this plant improvement.

A new cleaning method called "Peel-Off" was successfully tested. A peel off lacquer has been developed by a chemical company in Germany in close collaboration with a staff member at ESO Garching. The efficiency of this cleaning is very good as both the reflectivity and rugosity reach 95% of the values reached after a fresh aluminisation. A program to monitor the time dependent adherence of the aluminium will start soon. It is hoped that this technique will reduce the number of risky mirror handling operations.

Meanwhile, CO_2 snow flake techniques are used to maintain the mirror reflectivity within an acceptable range. The frequency of the cleaning is still under study, but it seems that the dust conditions at La Silla will force us to clean every two weeks. The recently deposited dust must be removed before it sticks. Unfortunately, this method of cleaning must be avoided during conditions of high humidity. These conditions are common during the Chilean summer, so the mirror reflectivity decreases beyond the restoring powers of the CO_2 snow flake technique. This would be a good period for the promising peel off techniques to be applied.

The aluminisation plant for the larger mirrors was also recently refurbished by VTD, a German vacuum company. The 2.2m main mirror aluminisation is scheduled for April '96, while the 3.6 m aluminisation is scheduled for June '96 (see article by Alain Gilliotte). The NTT mirrors will be aluminised during the coming "big bang" period, after June '96.

The Seeing at the 3.6m Telescope: Status of the Study

S. GUISARD

A first series of test nights dedicated to study the seeing at the 3.6 m telescope commenced in September this year and will conclude in February 1996. During these tests, both the seeing and the pupil image are continuously recorded in order to allow for a better understanding of the phenomena.

The actions taken so far have concentrated on tracking down and suppressing heat sources inside the dome, especially near the light beam. The encoder of the Cassegrain rotator and the electronics rack on the M2 unit are two examples. The former was insulated from the beam. It is located 20 cm from the beam at 1 meter from the Cassegrain focus. The latter, which was dissipating about 60 watts in the centre of the beam, is now only switched on when focusing is required.

Current work includes a preliminary approach to ventilate the mirror and a study for cooling the electronic racks in the cage, which generate several hundreds watts.

A seeing database is now used at the workstation in the control room. It is dedicated to recording and archiving the seeing measurements made every night. The software allows for automatic recording of all environmental conditions; temperature inside the dome measured at 15 various locations, wind speed and direction, slit direction, outside seeing at the seeing monitor (dimm2), etc. This data is saved each time a seeing measurement is made. This is done at least once per night. These measurements are straightforward and quickly made; it takes less than 30 seconds for the night assistant to enter into the data base the seeing, the zenith distance, and to specify the wavelength of the instrument. All the other information is transferred automatically to the workstation. In parallel, a programme running on a PC continuously records and displays environmental conditions.

A preliminary conclusion of the changes made to the 3.6 m and the results obtained will occur after the February test nights. Improving the seeing at the 3.6 m is a long term study; there are many parameters involved, and the problem cannot be solved in a few months. Other test nights will be requested during the coming periods to continue this programme for improving image quality.

Calibration of the IRAC2B Fabry-Perot

C. LIDMAN & R. GREDEL

The performance of the warm Fabry-Perot (FP) used with the IRAC2B camera on the 2.2 m telescope has now been characterised.

Across the array, the wavelength of maximum transmission varies. Using lens LC, the variation amounts to 8 Å over the central section, but from the center to the edge it is more than 16 Å. The variation is caused by a combination of two effects: a tilt added to the FP relative to the optical axis so that a bright thermal ring lies near the edge of the array and not in the center, and a higher than anticipated error in the non-flatness of the FP plates. These effects are inherent to the system and also occur with other imaging FPs (cf. Aspin et al. 1992 MNRAS 258, 684; Inoue et al. 1993 PaSJ 45, 539).

A map of the wavelength shift can be made by scanning a bright night sky line. The line at 2.18 microns is particularly well suited for such a task. Recent tests have shown that the shift can be determined to within 1 Å, and, over the central one arc minute of the array (using lens LC again), the map appears to vary little from one run to the next. However, this does not mean that the map does not vary with wavelength. This is still to be determined.

Instrumental fluxes of lines that are narrower than the instrument resolution, which is near 15 Å, can be recovered to about 5% if six wavelength settings are employed, four across the line and two well separated from the red and blue wings of the line. For lens LC, this result applies to the central one arc minute of the array. Flat-fielding, sky-subtraction and correction for the illumination pattern are done following the procedures used for broadband imaging. It is very important that dome flats be obtained for each wavelength setting.

The conclusion from this extensive testing is that the FP on IRAC2B can be used for studies that want to determine either line fluxes, velocity fields or both.

IRAC1

C. LIDMAN

Many projects employing IRAC1 image in the near IR, 1 to 2.5 microns, as well as the mid IR. As IRAC2B is significantly more sensitive in the near IR, we strongly recommend to observers who are planning observations in this wavelength region to combine observations with IRAC2B and IRAC1. To those observers who will have time on IRAC1 in the near future, we would like you to consider whether or not you can complete some of your programme using IRAC2B. It is sometimes possible, schedule permitting, to observe with IRAC1 and IRAC2B during a scheduled IRAC1 run.

We wish to emphasise that broad band M is not currently possible with IRAC1. The background flux is simply too high for the shortest integration now available. There are, however, two narrow band filters available, MN1 and MN2. These filters are about four times narrower than broad band M. Observers should realise that this reduces the sensitivity of IRAC1 at M.

ADONIS unveils Ultra-compact H II Regions Morphology

B. STECKLUM, T.L. HAYWARD, M. FELDT AND M. LÖWE

Until recently, the spatial resolution of infrared observations did not permit us to decide whether a single star or a dense stellar cluster powers the Ultra-compact H II regions (UCHRs). From radio interferometric observations, there is evidence for the presence of binary or multiple systems of massive stars. Conventional near-infrared (NIR) imaging has great difficulty in resolving this issue. The typical distance of several kiloparsecs to UCHRs implies that very high angular resolution is required to resolve the star forming complex into single stars. Furthermore, the diffuse radiation (due to thermal emission, recombination lines, and scattering) from the UCHR enhances the background against which the embedded stars have to be detected.

The advent of ADONIS (Adaptive Optics Near Infrared System) at the 3.6m telescope now allows us to disclose UCHR morphology. As an example, we show the first results obtained for one such object in August 1995. The object (G45.45+0.06) is a cometary UCHR (Wood and Churchwell 1989) with a sharp ionisation front almost east-west aligned. A single star of spectral type O 7.5 can account for the observed radio flux. The detection of NH_3 emission indicates the presence of dense molecular gas (Churchwell et al. 1990). The kinematic distance to G45.5+0.06 is 6.6kpc.

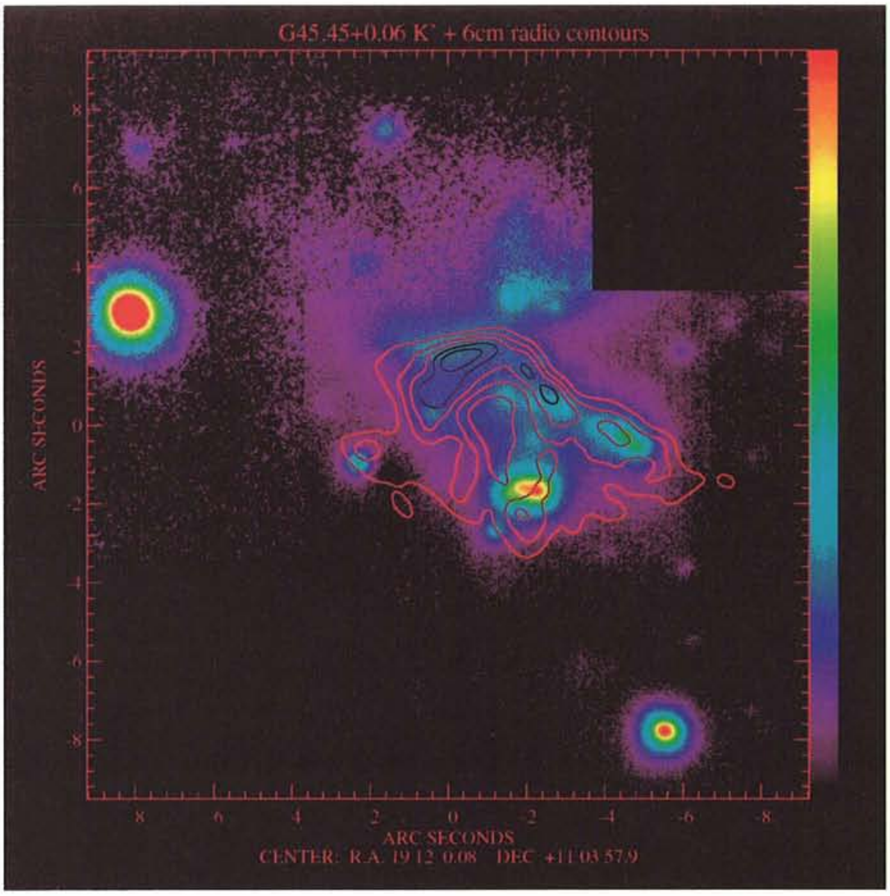


Figure 1.

The displayed image was obtained with the SHARP II camera (Hofmann et al. 1991) through the K' filter. The FWHM of the stellar profiles is 0.4 (during the observations the seeing monitor reported 1 seeing). This image reveals a cluster of stars, embedded in nebulosity, at the position of the UCHR. A chain of six stars almost coincides with the ionisation front. South of this arc, there is an object with a head-tail structure that does not have an obvious counterpart at radio wavelengths. Deconvolution of this image discloses that a jet like feature emerges from this star which is associated with H emission. The very good spatial resolution could be achieved because it was possible to close the loop on a bright star in the field.

Other targets of our UCHR sample share similar properties which supports the suggestion that the morphology of ionised gas and warm dust are often very different (Hayward et al. 1994). Our adaptive optics and MIR imaging suggests that UCHRs are very compact star clusters with members of different mass and evolutionary state.

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First Light on COMIC and SHARP II+

The ESO Adaptive Optics Group and F. LACOMBE, O. MARCO, F. EISENHAUER, and R. HOFMANN

COMIC and SHARP II+, the new high resolution cameras for the ESO adaptive optics system ADONIS, were commissioned in November 1995.

COMIC, developed by a group from Meudon Observatory, operates between 1 and 5μm but is optimized for the 3 to 5μm wavelength region. Two image scales are available: 35 mas/pixel (for J, H

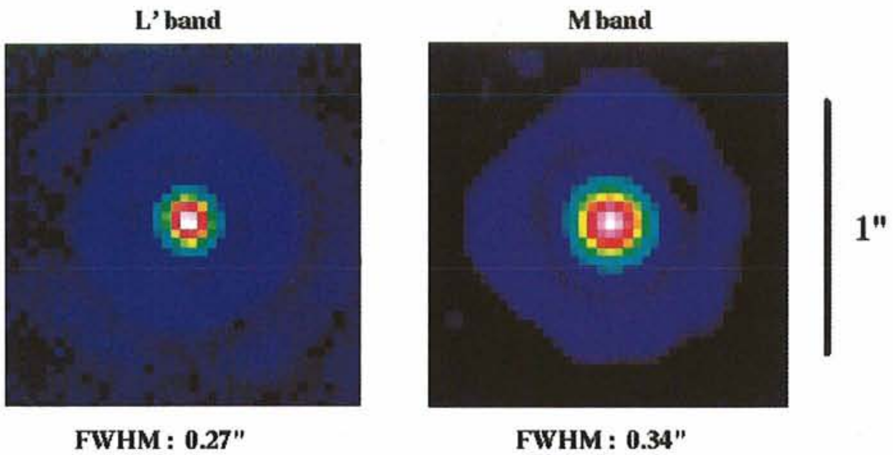

Figure 1: *51 Pegasus with COMIC.*

and K) and 100 mas/pixel (for L and M), leading to a field-of-view of 4.5 x 4.5 arcsec and 12.8 x 12.8 arcsec, respectively. Several narrow band filters and 2 CVFs covering the 1.3 – 2.5 μm and 2.5 – 4.5 μm ranges, respectively, are available. A 128 x 128 array manufactured by LIR is used as detector, and its associated electronics was built by Grenoble Observatory.

The first astronomical object which was observed with COMIC is the bright solar type star 51 Pegasus. Radial velocity studies by Mayor and Queloz (1995) provide convincing evidence for the presence of a planet with a mass of the order of that of Jupiter. The L and M images, displayed above, do not show any structure around the star.

SHARP II$^+$ operates between 1 and 2.5μm. It was developed by the Max Plank Institut für Extraterrestrische Physik (MPE) on the basis of the IR camera which was used until now with ADONIS. SHARP II$^+$ is equipped with an Atmospheric Dispersion Compensator unit (ADC), a Polarimeter, and two Fabry-Perot etalons covering the K-band with spectral resolutions of 950 and 2600 and an effective finesse of 40 and 51, respectively. The standard J, H, K and K' and various narrow band filters are available, as well as a CVF covering the H and K bands. The detector is a 256 x 256 NICMOS 3 array manufactured by Rockwell. Three image scales are available for the whole 1 – 2.5 μm wavelength range: 35 mas/pixel, 50 mas/pixel, and 100 mas/pixel, leading to a field-of-view of 9x9 arcsec, 12.8 x 12.8 arcsec and 25.6 x 25.6 arcsec, respectively.

In order to compare the performance of the new camera with the old SHARP II, previously used with ADONIS, we have observed the object G45.45+0.06, described above in the note from Stecklum et al. The image shown below was obtained through the K'filter, with a pixel size of 50 mas, which is the same as that used by Stecklum et al. The ADONIS correction is not as good as that obtained by Stecklum, however, as the object was already at an airmass of 2.6 when it was observed! The exposure time was 100 seconds on the object and 100 seconds on the star (three time less than for the Stecklum et al. image). The new image shows a clear brightening of the extended source.

Together with the two new cameras, a new user interface and a new data acquisition programme were installed and debugged. The new software, and SHARP II$^+$, are now being offered to visitors on a regular basis. A more detailed technical description of COMIC will be included in a future issue of The Messenger.

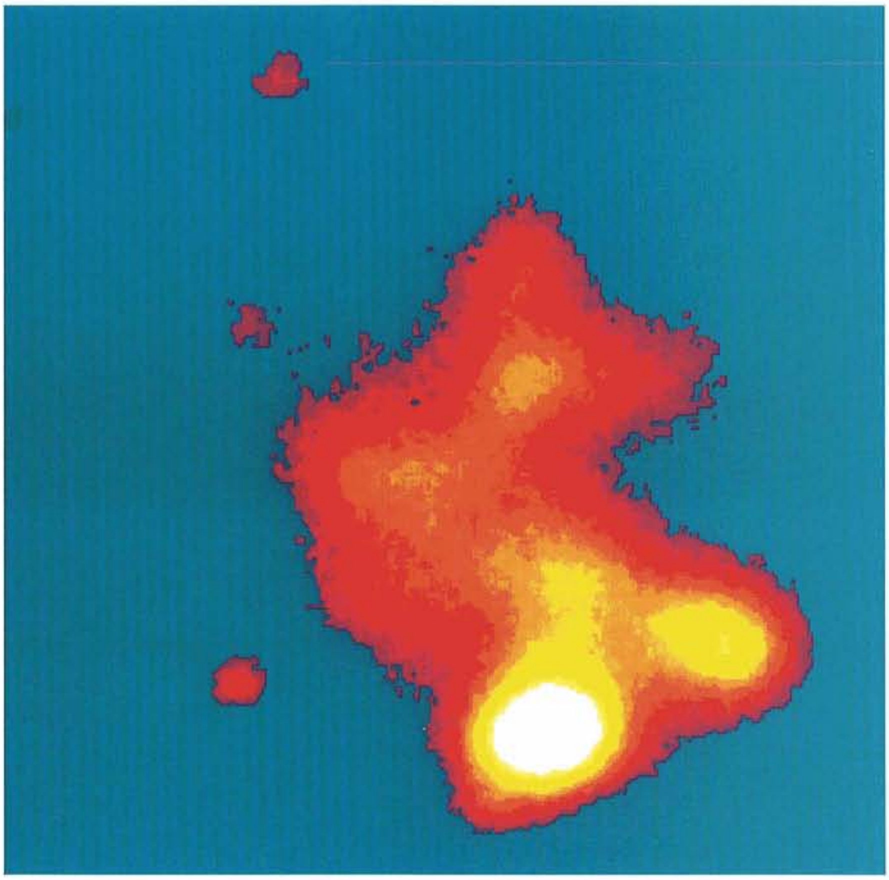

Figure 2: *G45.45+0.06 with SHARP II$^+$.*

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Mayor, M., and Queloz, D., 1995: in the *9th Cambridge Workshop* on "Cool Stars Stellar Systems and the Sun" held in Florence (Italy), 3–6 October 1995; R. Pallavicini and A. Dupree, eds. (in press)

An unusual view of the first VLT mirror taken from the top of the test tower during the final acceptance test performed in November 1995. This records one of the last walks on the mirror! The human presence gives an idea of the size of the VLT mirror.

NTT-SUSI images of superb seeing (0.34"-0.40"): Terzan 5

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The study of globular clusters in the Galactic bulge can provide information on the behaviour of metal-rich populations, through their colour-magnitude diagrams (CMDs) and element abundances, and can be a major piece of evidence regarding the timescales for formation of our Galaxy through their ages derived from CMDs (Ortolani et al. 1995a). Besides, the derivation of their distances and metallicities should make it possible to better establish the structure of globular cluster distribution in the bulge.

High quality images are necessary to derive clear CMDs in such crowded regions with high obscuration and differential reddening.

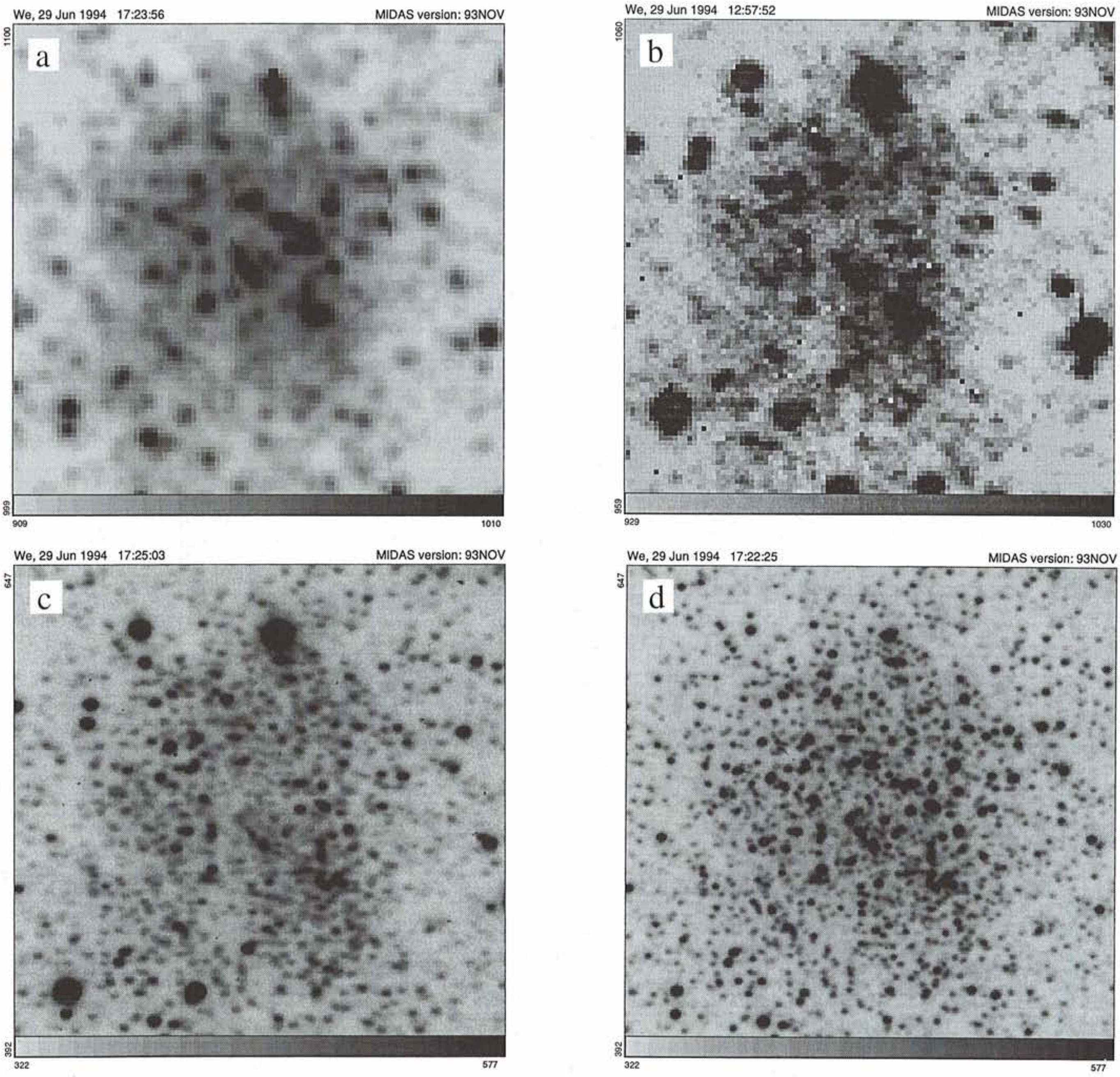

Figure 1: – *Terzan 5 images obtained with: (a) EMMI I image with seeing 1.2"; (b) EMMI V image with seeing 0.8"; (c) SUSI V image with seeing 0.65"; (d) SUSI I image with seeing 0.34".*

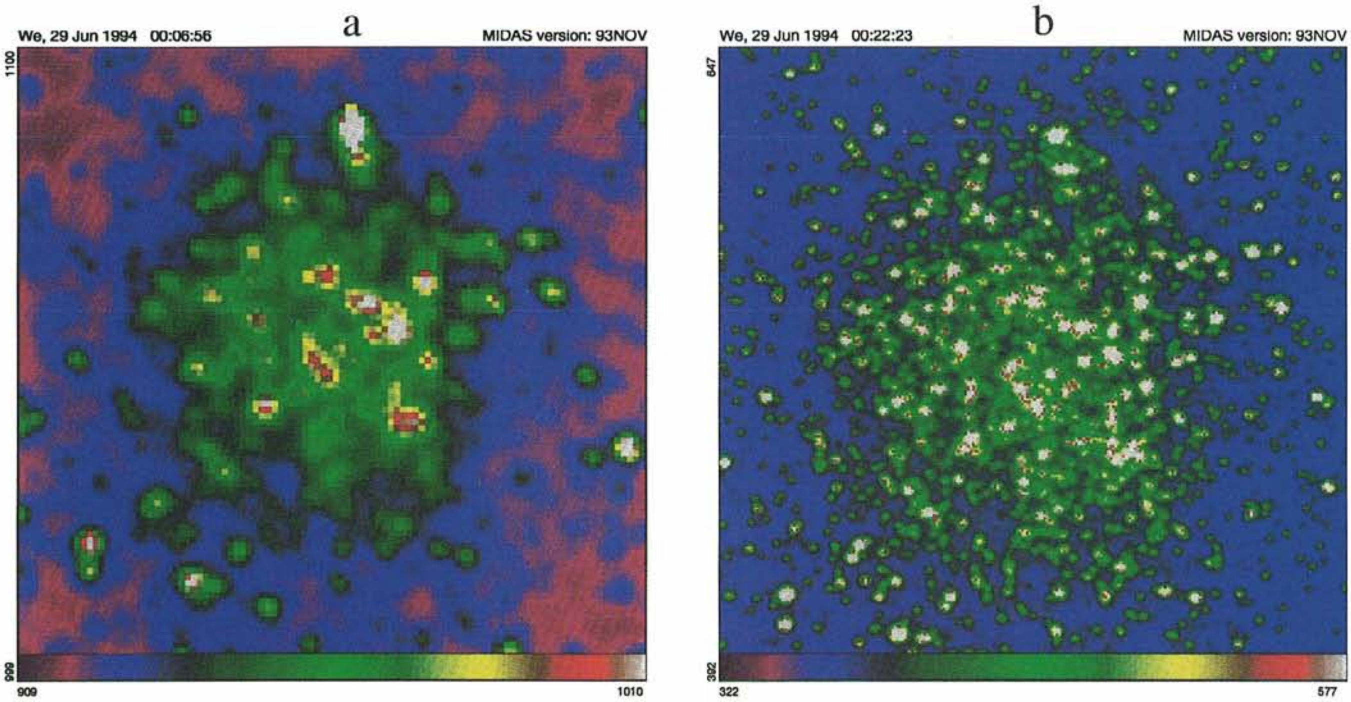

Figure 2: – *Terzan 5 images shown in colours: (a) EMMI I image with seeing 1.2" – same as Fig. 1a (b) SUSI I image with seeing 0.34" – same as Fig. 1d.*

An unprecedented high quality image for Terzan 5 with a seeing of 0.34" was obtained with the NTT equipped with SUSI in May 1994. A comparison with previous images obtained with EMMI under less good quality seeing illustrates the need for the high quality images. Our main goal in the last few years has been to obtain such high quality photometry, but only now has NTT equipped with SUSI permitted such results.

Observations

Terzan 5 was observed at the ESO New Technology Telescope (NTT) equipped with EMMI in June 1993 and with SUSI in May 1994. An unprecedented image quality was obtained for Terzan 5 in the May 1994 run, in particular for a 60s I image with a seeing of 0.34".

In the 1993 observations, the NTT was equipped with EMMI operating in the focal reducer mode, at the red arm. The detector was a LORAL front illuminated CCD (ESO # 34), with a pixel size of 15μm (0.35" on the sky). The whole size of the CCD is 2048 x 2048 pixels, but it was read out in the format 1700 x 1400 pixels (9.9' x 8.1' on the sky) excluding peripherical vignetted regions.

In June 1994 the observations were carried out at the Nasmyth focus B, with a 1024 x 1024 thinned Tektronix CCD (SUSI camera). The pixel size is 24 μm (0.13" on the sky) with a total 2.2' x 2.2' frame size.

The images were processed using the MIDAS package at ESO-Garching computer center. After the standard flatfield corrections, instrumental magnitudes have been obtained using DAOPHOT II.

The effect of improvement of seeing is illustrated in Figs. 1a,b,c,d where a sequence of improved seeing is shown for Terzan 5 images obtained with: (a) EMMI I image with seeing 1.2"; (b) EMMI V image with seeing 0.8"; (c) SUSI V image with seeing 0.65"; (d) SUSI I image with seeing 0.34". One clearly sees the

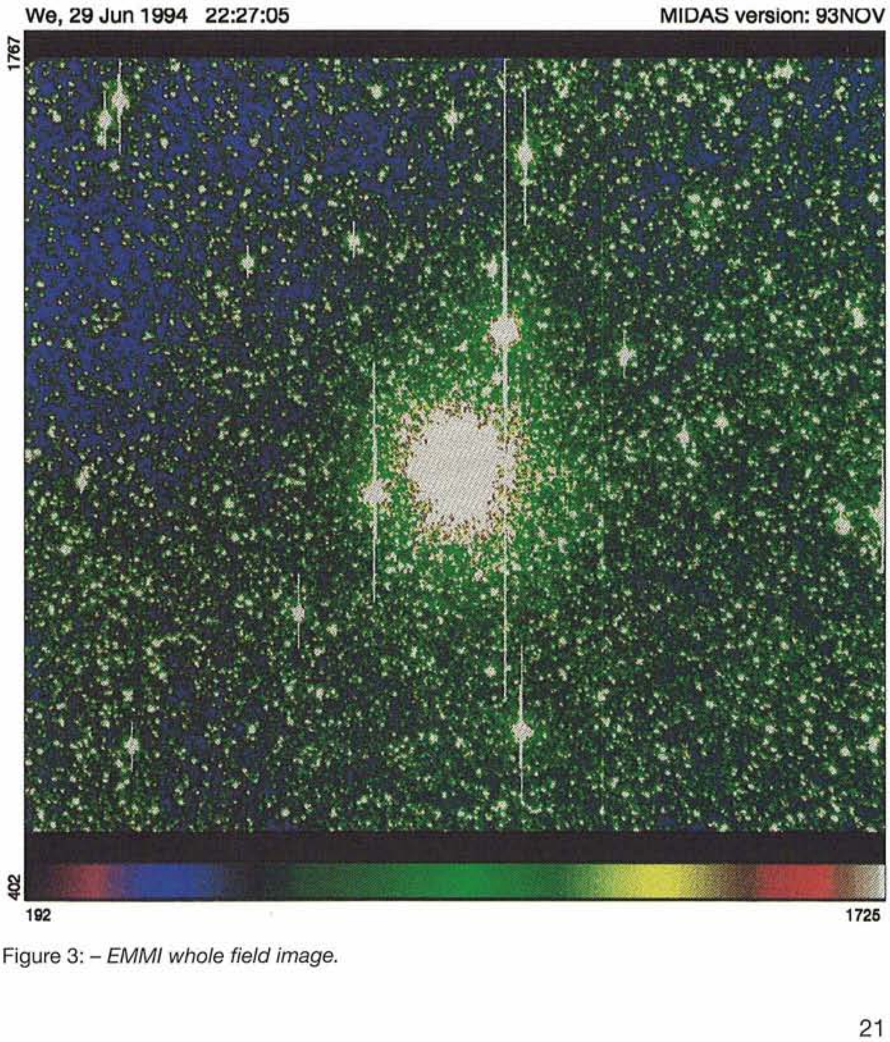

Figure 3: – *EMMI whole field image.*

improvement of image quality from the 1993 EMMI images (Figs. 1a, b) to the 1994 USI ones (Figs. 1c, d), where many more stars are resolved and much fainter limiting magnitudes are reached in considerably shorter exposure times.

The seeing effect can be even better seen in Figs. 2a,b in colours, showing I images corresponding to Figs. 1a and 1d respectively.

In Fig. 3 is shown an EMMI whole field image (seeing 1.3") where it is shown that, on the other hand, EMMI provides a large field (9.9'x8.1') relative to SUSI (2.2'x2.2').

The image quality improvement is the result not only of the better sampling of SUSI but also due to the effort in keeping the best optical quality during the observations, through continuous image analysis and a very careful focussing. This was possible thanks to the active collaboration of the ESO technical staff.

Colour-magnitude diagrams

The effect of seeing on the CMD quality is illustrated in Fig. 4 (SUSI) and Fig. 5 (EMMI): note in particular that the SUSI diagram reaches about 1.5 magnitudes deeper besides a much sharper definition of the main features which are: the blue disk main sequence on the left side, the cluster horizontal branch (tilted and elongated by differential reddening) and the red giant branch showing a faint red tip.

Finally, this study permitted us to derive parameters for Terzan 5: a reddening of E(B-V) = 2.49 and a distance to the Sun of $d_\odot$ = 5.6 kpc (closer than previous estimates). Also, based on the red

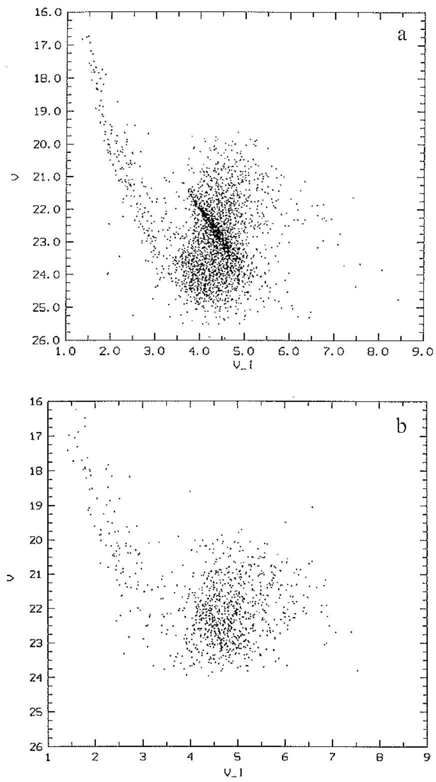

Figure 4: – *V vs. (V-I) colour-magnitude diagrams of Terzan 5 obtained with (a) SUSI (seeing 0.34") and (b) EMMI (seeing 1.3") with an extraction corresponding to the same frame area of SUSI.*

giant branch curvature, we derive a metallicity somewhat higher than that of NGC 6553, probably solar. More details on Terzan 5 are given in Ortolani et al. (1995b) It is a peculiar cluster, resembling other bulge clusters such as NGC 6553, NGC 6528, Liller 1 and Pal 6 among others (Ortolani et al. 1990, 1992, 1995c,d and references therein).

Conclusions

The exceptional high quality images allowed us to approach the HST (Wide-Field PC2) resolution (where about 0.1" is reached) with the advantages of a constant point spread function along the frame and easy calibration to the standard Johnson-Cousins systems, besides a larger field of view. This was possible thanks to a combination of good seeing and the intrinsic optical quality of NTT.

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New Globular clusters identified in the inner regions of NGC 5128 using ESO and HST Data

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Introduction

The study of globular cluster systems leads the way in our understanding of galaxy formation. In distant galaxies, the observational evidence in favor of globular cluster formation during merger episodes is rapidly growing. This mechanism naturally accounts for the high specific frequency of globulars observed in elliptical galaxies (e.g., Ashman Zepf 1992).

A very special case for the study of globular cluster formation in such violent events is NGC 5128 (Cen A), the nearest giant merger galaxy (Sérsic 1982). This galaxy has a very rich system of globular clusters, with membership of part of them confirmed spectroscopically (Sharples 1988). However, there are only very few known clusters in the inner regions of this galaxy (Sharples 1995). Consequently, the basic question about the existence of super-metal-rich clusters in NGC 5128 remains unanswered (see Jablonka et al. 1995). These putative super-metal-rich clusters are expected to be found preferentially in the inner regions, since in our Galaxy about 90% of these globulars are confined to the inner 3 kpc (Minniti 1995).

The usual problems inherent in the identification and study of globular clusters in the inner regions of distant galaxies are faintness, crowding, high background galaxy light, nonuniform extinction, foreground contamination by stars in our own galaxy, and background contamination by distant galaxies. In this work we take advantage of the combination of archive HST data with our ground-based IR observations in order to overcome these difficulties. We study the globular clusters in the inner 3 kpc of the peculiar E2 galaxy NGC 5128 (Figure 1).

Identification of Globular Clusters

We use archive F675W images obtained with the WFPC and the (pre-

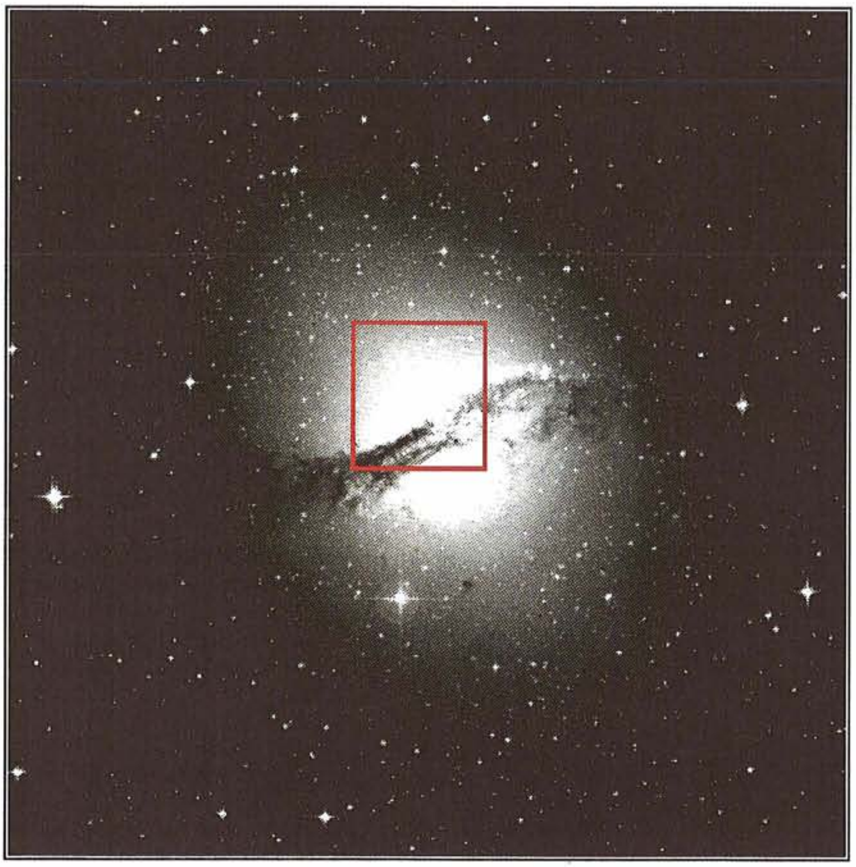

Figure 1: *NGC 5128 (Cen A) as seen from the Digital Sky Survey (30 x 30 arcmin²). The location of the JHK mosaics is indicated. North is up and East to the left.*

COSTAR) HST in order to identify globular clusters in the inner regions of NGC 5128. The F675W filter is essentially equivalent to the Cousins R filter (Harris et al. 1993), and to the Washington T1 filter (Geisler 1996). We have then calibrated the HST frames with existing ground based photometry in the T_1 filter for a few known globulars in this region from Harris et al. (1992).

The typical core diameters of Galactic globular clusters are $D_C = 6$ pc, with a total range from about 1 to 20 pc, as listed in the most recent compilation by Harris (1995). At a distance of 3 Mpc this diameter translates to ~0.32 arcsec. These sizes can be resolved thanks to the superb spatial resolution of the WFPC (0.1 *arcsec/pix*), giving $D_C \approx 3$ WFPC pixels. Thus, foreground stars can be distinguished from typical globular clusters in NGC 5128. At the same time, Galactic globular clusters are almost round, which gives an extra criterion for the discrimination against background galaxies.

Then, the basic procedure for identifying globular clusters is by looking at their sizes and ellipticities. Figure 2 shows a plot of ellipticity FWHM of sources in the PC4 frame, where three known globular clusters (members of NGC 5128 from their radial velocities) are identified. Note that this procedure clearly produces an incomplete list of globulars, where extremely compact or very loose ones are missed. However, based on their morphology, the candidates on our list can be considered bonafide globular clusters.

The IR Photometry

The HST images are complemented here with our deep near-IR images,

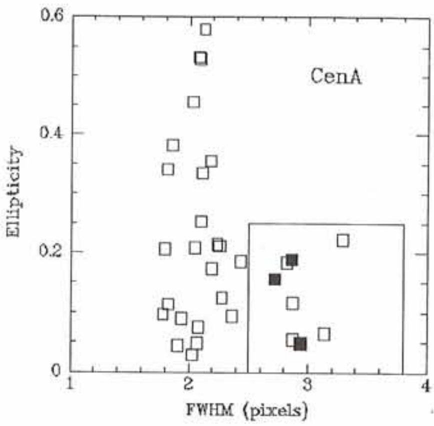

Figure 2: *Ellipticity vs. FWHM of all the sources identified in the PC4 chip down to R = 21 mag. The loci of the globular clusters G206, G268 and G359 (Harris et al. 1992) are indicated (filled squares). The region used to select potential globular clusters in all the chips of WFPC is enclosed with the solid line.*

which have the advantage of high contrast and reduced reddening sensitivity. The inner structure of NGC 5128 is complicated by the presence of large and non-uniform extinction. The surface magnitude of the underlying galaxy ranges from $\mu_K = 12$ to 16 *mag arcsec*$^{-2}$ in the region observed here. It would have been challenging to try to identify the clusters on top of the galaxy light without the aid of the HST images.

The observations were obtained with IRAC2B at the ESO 2.2-m telescope during March 4, 1995. We mapped a region of 3x3 *arcmin*² with the *JHK* filters, centered at about 1 arcmin NE of the nucleus of the galaxy (see Figure 1). We also mapped a comparison field located at about 30 arcmin NE of the nucleus, in order to estimate back- and foreground contaminations.

The photometric reductions were done using the aperture photometry packages in IRAF. The achieved limiting magnitudes are $K = 18$ *mag* and $J = 19.5$ *mag*, which are complementary to those of the WFPC images, $R = 21$ *mag*. These limiting magnitudes reach clusters beyond the peak of the globular cluster luminosity function in NGC 5128.

The positions of the globular cluster candidates are displayed in Figure 3, along with the location of the HST frame. The cluster IDs, coordinates, magnitudes, and radial distances from the nucleus are listed in Table 1. The x and y

TABLE 1.

ID	x	y	T_1	r	Comments
1	326.3	20.6	19.43	2.1	
2	150.0	35.7	18.53	2.6	G268
3	242.0	42.0	20.90	2.1	
4	268.0	55.0	20.46	2.0	
5	174.2	59.6	20.12	2.3	
6	228.1	77.3	18.00	2.0	G242
7	301.0	87.0	20.05	1.6	
8	180.6	102.9	18.91	2.1	
9	218.5	122.0	20.51	1.7	
10	112.1	133.2	18.55	2.4	G206
11	188.8	137.1	18.50	1.8	
12	117.0	153.0	19.75	2.3	
13	91.2	169.8	18.24	2.4	G359
14	225.1	184.9	19.75	1.4	
15	235.1	188.2	17.09	1.3	
16	8.3	189.9	19.34	3.0	G292
17	179.3	216.8	18.53	1.6	
18	239.1	225.0	17.39	1.1	
19	11.1	234.7	18.97	2.9	G169
20	257.9	238.0	20.05	0.9	
21	245.5	252.0	19.38	1.0	
22	144.2	268.2	20.05	1.8	
23	154.0	269.0	20.51	1.7	
24	162.0	280.0	19.62	1.7	
25	186.8	284.1	19.17	1.5	
26	231.0	285.0	20.08	1.1	
27	161.0	294.0	20.81	1.7	
28	153.6	319.7	19.34	1.8	
29	291.0	97.0	21.91	1.6	
20	368.0	101.0	20.74	1.4	
31	368.0	107.5	21.83	1.4	
32	212.0	322.0	20.71	1.3	

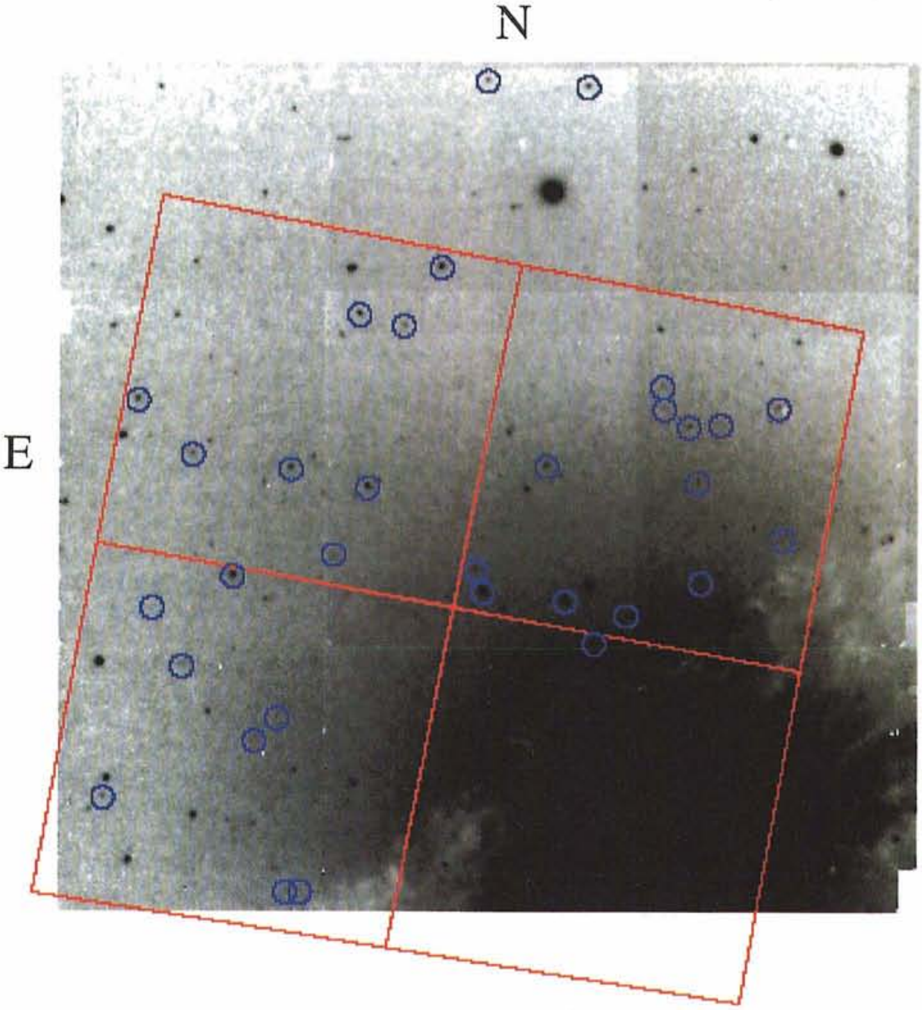

Figure 3: *H mosaic of the central region of NGC 5128 observed with IRAC2B at the La Silla 2.2-m telescope. The location of the WFPC frames is shown in red. The globular cluster candidates are indicated with blue circles.*

coordinates are measured in pixels (scale=0.49 arcsec/pix) with origin in the lower left corner of the mosaic, and the radial distances are measured in arcmin.

Reddening maps are constructed by dividing the different color frames. Based on these maps, it was decided to study the candidates away from the inner region enclosed by the prominent dust lane, shown in Figure 3. Even though the majority of the sources were detected in this region, it is not trivial to evaluate the amount of reddening affecting these different sources.

JHK photometry in the comparison field allows us to estimate the completeness of the present sample. We have identified 30 globulars based on their morphology. Matching the number counts in the field with those of the comparison field gives a total of 50 expected globulars in the region studied down to $K = 18\,mag$. We also estimate that there should be only about 5 galaxies present in our field, most of which would have been eliminated from our list based on their morphology.

Figure 4 shows the optical-IR color-magnitude diagram for the cluster candidates. Their location in this diagram and in the color-color diagrams matches the locus expected for globular clusters found in Local Group galaxies. Therefore, from their sizes and shapes as well as from their colors, the candidates in our list seem to be globular clusters.

Summary and Final Remarks

We have identified globular clusters in the inner regions of NGC 5128, the nearest known large galaxy product of a merger. The clusters are selected on the basis of their structural parameters (observed core diameters and ellipticities), as measured from deep WFPC HST images. These identifications are confirmed by IR photometry obtained with IRAC2B at the ESO 2.2-m telescope.

This new sample of clusters, deep into the core of NGC 5128, represents a basis for the measurement of the distance to NGC 5128, for the determination of the metallicity gradient in the globular cluster system, and for the study of the history of cluster formation in such a recent merger event.

Acknowledgements: This work is dedicated to the memory of Jose Luis Sérsic. M. V. Alonso acknowledges support from the ESO Visitor's Program.

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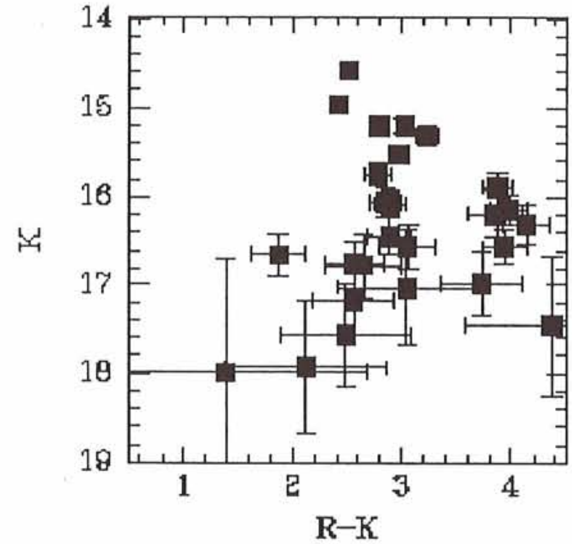

Figure 4: *Color-magnitude diagram for the globular cluster candidates.*

Activity in galaxies

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In a long term project, we are investigating in various types of galaxies two fundamental quantities: the gas content M_{gas} and the luminosity L_{IR}. It is the main result of this study that the stage of activity can be well described by the ratio L_{IR}/M_{gas}, i.e. by the efficiency of producing luminosity out of a given gas reservoir.

Introduction

Most galaxies maintain their luminosity by the formation of stars – a process that normally proceeds rather quietly, for example, throughout the galactic disk in case of the Milky Way, but which can also appear as an explosive event, as in the center of an active galaxy, like M82. A few exotic objects, radio galaxies and quasars, possess an additional source of energy, probably an accreting black hole. Both star formation and black holes are fueled by the interstellar gas, and about ten years ago it was suggested that the ratio luminosity over gas mass, L/M_{gas} is linked to activity. For the Milky Way, a "normal" galaxy, this number is about 5, whereas significantly higher values are observed in active systems. In order to put the proposition, that L/M_{gas} is an indicator of activity, on a firm footing one has to reliably determine the two fundamental quantities L and M_{gas} in various types of galaxies.

Luminosity and Gas Mass

A galaxy radiates not only in the optical region, but over the entire electromagnetic spectrum, from X-rays to radio waves. During the last two decades it became clear that many output a large fraction of their total luminosity in the infrared part of the spectrum. This is due to the fact that the stellar radiation is absorbed by interstellar dust and re-emitted at longer wavelengths. Even for the Milky Way, this fraction is one third and in some galaxies it exceeds 90%. Let us define the IR luminosity as the energy emitted per unit time between 12 μm and 1300 μm = 1.3 mm. The limits are somewhat arbitrary: The lower bound comes from the infrared satellite *IRAS*, which twelve years ago conducted an all-sky survey in four filters at 12, 25, 60 and 100 μm, and the upper bound of 1300 μm marks a convenient observing band. Measurements at other wavelengths are rare because, but for a few atmospheric windows around 400 and 800 μm, they cannot be done from the ground. The important point is that between 12 μm and 1300 μm radiation by dust is the dominant emission process.

The gas content of a galaxy consists of two major components. In one, hydrogen is atomic (HI) and can be detected by its hyperfine transition at 21 cm; in the other, it is molecular (H_2) and can usually not be seen directly. To detect a cloud of molecular hydrogen, one has to observe a tracer whose emission must, of course, be sufficiently strong. In practice, this may either be dust, which is well mixed with gas independent of whether hydrogen is atomic or molecular, or carbon monoxide, a robust and easily excitable molecule. Models for the chemical composition of the interstellar medium predict that CO is roughly coextensive with H_2. As far as the spatial distribution in a galaxy is concerned, the rule of thumb says that atomic gas (HI) prevails in the outer regions, whereas molecular gas (H_2) is concentrated towards its center. In the Milky Way, the total masses of HI and H_2 are about equal, each $\sim 3\ 10^9\ M_\odot$.

Dust emission

Interstellar dust follows Kirchhoff's law so that at any wavelength the emission coefficient κ_λ equals the absorption coefficient times the Planck function $B_\lambda(T_d)$ taken at the dust temperature. T_d Now in the far IR, the dust absorption coefficient falls quickly with wavelength, approximately $\kappa_\lambda \alpha \lambda^{-2}$ so that for $\lambda > 50\,\mu m$ practically all interstellar clouds become optically thin. Consequently, the far IR flux S_λ observed from a galaxy at distance D is directly proportional to the dust mass M_d and related to it through

$$M_d = \frac{S_\lambda D^2}{\kappa_\lambda B_\lambda(T_d)} \qquad (1)$$

In the Milky Way, the amount of gas is about 150 times larger than of dust. Adopting this dust-to-gas mass ratio for other galaxies, one can infer from the above equation the total mass of interstellar matter, for convenience simply called the gas mass M_{gas}.

Emission from CO

Rotational levels of CO are mostly excited in collisions with hydrogen molecules and helium atoms. The lowest radiative transition from rotational level J=1 down to J=0 has a wavelength of 2.6 mm, the next higher from J=2 to J=1 is at 1.3 mm; the lines are simply denoted by (1–0) or (2–1). It takes a density of a few hundred particles per cm³ to thermalize the J=1 level, i.e. to populate it close to the value of thermal equilibrium at the given kinetic gas temperature. For the J=2 level, the required density is an order of magnitude higher.

Suppose that we direct our telescope towards the core of a galactic cloud. The density there is usually high and the J=1 and J=2 level are both thermalized. Consequently, the (1–0) and (2–1) lines of CO have the same antenna temperature (this is a radio astronomical unit for intensity and is measured in K). Quite contrary to this, in a CO observation of a galaxy we see not only cloud cores, but all gas, also the diffuse cloud envelopes, and the (2–1) line may well be less excited than (1–0) and thus weaker.

When we integrate the intensity in the line over the full velocity range, this is graphically just the area under the line, and multiply by the square of the distance to the source, we obtain a quantity called CO luminosity, L_{CO}. It has been verified empirically to be proportional to the gas mass, at least, roughly:

$$M(H_2) = \beta L_{CO} \qquad (2)$$

The justification for this relation is a bit obscure and it is an important problem to find experimentally the factor, which has a different value for the (1–0) and (2–1) transition, and check whether indeed it is constant. In essence, when we use the CO luminosity for estimating the gas mass, we are dealing with a dynamical method. Measuring a CO line of a single molecular cloud, Eq.(2) holds when the cloud is in virial equilibrium, so that the line width is determined by the cloud mass, and the line temperature does not deviate much from a mean value. On the other hand, when we look at a galaxy, where we have many clouds in the telescope beam, the observed line is a linear superposition of many lines, each arising from one individual cloud. Therefore Eq.(2) stays in force, although the width of the line, now typically 200 km s^{-1}, is determined by the rotational velocity of the galaxy and thus by the mass of the stars, and not the gas. In the inner regions of galaxies, where hydrogen appears only in molecular form, we can thus measure the total gas mass after Eq.(2).

Observations

The bulk of dust in a galaxy is at rather low temperatures (20...40 K) and the spectral energy distribution has its maximum typically between 100 and 200 μm. Nevertheless, experience has shown that, when all technical aspects like telescopes, receivers or atmospheric transparency are included, a wavelength of 1300 μm is best suited for observing dust in galaxies.

The observations, we are talking about here, have been conducted at the SEST, the JCMT and the IRAM 30m telescope. For the measurement of the dust emission, we used ^{3}He cooled bolometers operating at 450, 800, and 1300μm. The observing technique is identical to that at near IR wavelengths, i.e. one performs differential ON–OFF measurements in order to suppress atmospheric fluctuations. A crucial aspect of these observations is the determination of the atmospheric transmission which, especially at submm wavelengths, is severely reduced by the water vapor of the atmosphere. For this purpose, one measures the emission of the sky (which does not only absorb, but also emits) at different elevations. The fluxes were calibrated on the planets Mars and Uranus. To account for the extent of the objects, we observed at several (up to seven) positions in the galaxy. At the SEST, the diffraction limited beam size at 1.3 mm is 24″. The beam separation was fixed at 70″; this ensured that the OFF beam was free of contamination from emission from the outer parts of the galaxies. Typical integration times were 30 minutes per position.

In addition, we also observed the lower rotational transitions of ^{12}CO at 1.3 and 2.6 mm. Here we could use highly sensitive, low noise SIS receivers available at the SEST and at the IRAM 30 m telescope. Integration times for a single spectrum ranged from one to three hours.

The Samples

From the compilation of Cataloged Galaxies and Quasars Observed in the IRAS Survey (Fullmer & Lonsdale 1989) we selected samples of normal spirals, active galaxies and radio-quiet quasars with the goal to determine their gas content M_{gas} and their IR luminosity L_{IR}. Normal spirals had to fulfill the condition that their flux density at 100 μm is larger than 10Jy and their optical diameter, D_{25}, smaller than 180″; in this way, we obtained 138 normal galaxies. Active galaxies were picked from the catalogs of Markarian et al. (1989), provided their 100 μm flux density is larger than 9Jy; this gave a sample of 49 active galaxies. The radio-quiet quasars were taken from Neugebauer et al. (1986); all objects with observations at 3 or 4 IRAS bands were selected, which amounted to a sample of 29 quasars.

Because of the relative faintness of the objects, we have not yet investigated all of them in detail. Nevertheless, we already now have a statistically meaningful number of galaxies, where we have data on the 1.3 mm dust emission and the CO (2–1) and (1–0) lines. As we have used different telescopes, we can also compare dust and CO observations made with identical beam sizes.

Results

In the following, we list some results from our comparative study. Tedious as observational work is, they have been presented in a dozen papers spread over almost ten years. For those interested, details and further references may be found in Chini et al. (1995 a,b).

7.1 Normal Spirals – The spatial distribution of dust was investigated by mapping the galaxies at different mm/submm wavelengths. It turned out that the distribution of dust is comparable to the optical extent of the sources. By contrast, the CO emission is much more concentrated towards the central region ($r \leq 2.5$kpc). Analyzing the spectral energy distribution between 12 and 1300 μm, we find that the region from 100 to 1300 μm is dominated by cold dust of $T_d = 15 \pm 5$ K which contains the bulk of mass. At shorter wavelengths, dust of higher temperatures ($T_d \geq 50$ K) is required, but its contribution to the total dust mass is negligible.

Using Eq.(1) to convert the 1.3 mm dust emission into a gas mass, and integrating the energy distribution from 12 to 1300 μm to derive the IR luminosity, we find a ratio $L_{IR}/M_{gas} = 5 \pm 2$. Our galaxies range in gas mass from $2 \cdot 10^9$ to $6 \cdot 10^{10} M_\odot$ and in IR luminosity from $6 \cdot 10^9$ to $3 \cdot 10^{11} L_\odot$.

7.2 Active Galaxies – Whereas in normal galaxies star formation and thus the luminosity are spread across the disc, activity is a property of the nucleus. Therefore, the spatial distribution of dust in Markarian galaxies is – by contrast with normal spirals – strongly peaked towards the nucleus; the same holds for the CO emission. Also the spectral energy distribution is different in the sense that a single dust component of 33 ± 5 K is sufficient to describe the data between 60 and 1300 μm. At shorter wavelengths, dust hotter than 100K is responsible for the emission. Applying Eq.(1) again yields a ratio $L_I/M_{gas} = 92 \pm 53$, which is about 20 times higher than for normal spirals. The gas masses in this sample are in the range $5 \cdot 10^7 \leq M_{gas} \leq 8 \cdot 10^{10} M_\odot$ and for the IR luminosities $5 \cdot 10^9 \leq L_{IR} \leq 3 \cdot 10^{12} L_\odot$.

7.3 Quasars – Quasars certainly belong to the most active objects in the universe. Most of them are radio-quiet. The energy distributions of these objects resemble those of active galaxies. For a long time they were interpreted as originating from (non–thermal) synchrotron radiation. During the last few years, however, it turned out that the FIR/mm emission is also due to dust heated to about 40 K. Therefore, one can use again the 1.3mm dust emission to determine the gas content in these objects. We found that the gas mass in radio-quiet quasars is comparable to that in active galaxies, but the ratio L_{IR}/M_{gas} is larger, approximately 550.

Discussion

We want to discuss two aspects of our study. One concerns the accuracy and reliability of gas mass determinations, the other the stage of activity of normal spirals, Mkn galaxies and quasars.

8.1 Mass Determinations – The methods for determining the gas mass, described in Section 3 and 4, are not totally on safe ground, particularly when applied to external galaxies. We have indicated the uncertainties with respect to the CO luminosity; for the interpretation of dust emission, the weak point lies in the poor knowledge of the mass absorption coefficient κ_{1300}. To estimate the errors of the two methods, we compare the resulting gas masses. We do this by plotting in Fig.1 the ratio of two purely observational quantities: CO luminosity L_{CO} and 1300 μm-luminosity $L_{1300} = S_{1300} D^2$. We can write this ratio in the following way

$$\frac{L_{1300}}{L_{CO}} = \frac{M_{dust}}{M(H_2)} \cdot \beta \cdot \kappa_{1300} \cdot B_{1300}(T_d) \quad (3)$$

i.e. as the product of the dust–to–gas ratio , the conversion factor β in Eq.(2), the absorption coefficient κ_{1300} per gram of dust, and the Planck function. The dust temperature T_d is determined independently by submm and IRAS observations. The data of Fig.1 refer to a subset of normal spirals where we have observed the central dust emission and the CO (2–1) line with the same beam.

The scatter in Fig.1 is surprisingly small and might even be entirely attributed to observational errors considering the uncertainties of about 20% associated with the dust and CO observations. Fig.1 therefore implies first that, provided we can calibrate the conversion of L_{1300} and L_{CO} into gas mass, both methods give the same result and should therefore be quite accurate. Second, the fundamental quantities R, β and κ – or at least their product times the Planck function – do not vary much from one galaxy to another. The last point becomes even more interesting when we realize that κ_{1300} is probably more or less constant because of the common origin of dust (old stars, supernovae) and the insensitivity to grain size at this wavelength.

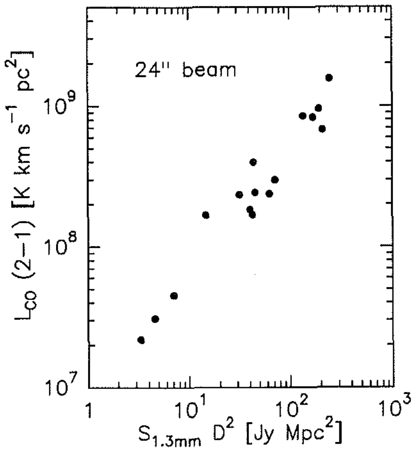

Figure 1: *The CO (2–1) luminosity L_{CO} vs. the luminosity at 1300µm L_{1300} for a sample of non-active spirals observed at SEST.*

8.2 The Stage of Activity – In Fig.2 we summarize the results concerning the ratio L_{IR}/M_{gas} for three classes of objects. We see that the luminosity itself is not an indicator of activity. For example, at luminosities from 10^{11} to $10^{12}L_{\odot}$, an extragalactic object may be a normal or an active galaxy or even a quasar. Put differently, out of a given gas mass one can produce significantly diverging luminosities. It is the efficiency of converting gas into luminosity, i.e. the quantity L_{IR}/M_{gas}, that determines the level of activity. Non-active galaxies are characterized by rather low values, of order 5. Active galaxies produce 20 times more luminosity out of the same reservoir of gas. The various L/M ratios reflect the vehemence of this process, extending from quiet star formation in galactic discs over explosive star bursts in galactic nuclei to quasars at the upper end of this sequence.

The high ratio L_{IR}/M_{gas} in Mkn galaxies may be explained within the framework of star formation by a combination of two effects. Either the star formation rate is enhanced compared to normal galaxies, i.e. more gas is transformed annually into stars (in the Milky Way $5M_{\odot}yr^{-1}$), or the initial mass function (IMF) is biased towards massive stars of high luminosity. (The IMF describes the relation between the number of stars formed simultaneously in a certain volume and their mass.)

Undoubtedly, the star formation rate is high in active galaxies. To produce a steady luminosity of $10^{10}L_{\odot}$ with a normal IMF, one needs to convert $1M_{\odot}$ of gas per year into stars. Therefore, activity has to end after at most 10^8 years

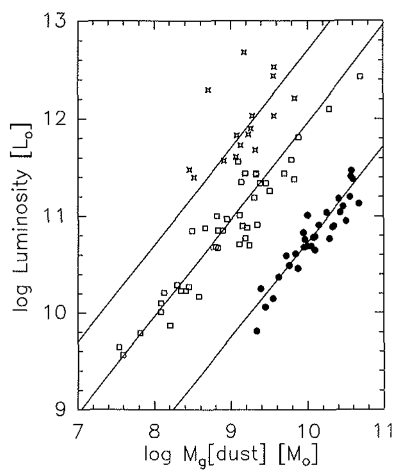

Figure 2: *IR luminosity L_{IR} vs. the gas mass M_{gas} for non-active spirals (•), active Mkn galaxies □ and radio-quiet quasars (⋆). The straight lines represent the loci of equal L_{IR}/M_{gas} with average values of 5 (normal), 100 (active) and 550 (QSO), in solar units.*

when all gas has been used up. It is a time limited phenomenon that occurs once or repeatedly in the nuclei of normal galaxies.

Most of their lifetime galaxies are located in the "non-active strip" of Fig.2, while occasionally they are excited to activity. The question arises what causes the transition from the quiet to the active phase. It has become clear that interaction and merging of galaxies and the subsequent transfer of gas into the nucleus plays an important role. The precise triggering mechanism is still debated. Our model computations show that under most conditions a gas-rich nucleus is intrinsically unstable towards star formation and a series of bursts (not just one) seems inevitable (Tutukov & Krügel 1995). They are based on the idea that the gas in the nucleus is supported against collapse by turbulent motions. As the turbulent energy is dissipated, the gas contracts and above some critical gas density star formation occurs. The following supernova explosions can replenish the turbulent energy so that the gas expands again. This cycle is repeated. If, for some reason, the turbulent energy of the gas is not sufficiently replenished by supernova explosions, gravity will pull the gas inwards and a catastrophic collapse towards a supermassive object ensues. This idea links star formation in galactic nuclei to quasars.

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Discovery of the first extra-galactic SiO maser, and the quest for more

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Red Supergiants (RSG) and stars at the tip of the Asymptotic Giant Branch (AGB) experience phases of heavy mass loss, which can reach values as high as $10^{-4}M_{\odot}$/yr. The physical conditions in the cool and dense circumstellar envelope (CE) allow dust to form: these stars may even be the main contributors of dust to the interstellar medium. Radiation pressure on the dust grains combined with collisional coupling between the dust and the gas drives the expelled matter away from the star.

The inner part of the CE is free of dust. How the matter is transferred from the stellar photosphere to the dusty part of the CE is not understood. The inner CE of cool evolved stars can best be studied through molecular lines. The most often used lines are the 43 GHz and 86 GHz masing transitions of SiO: SiO is highly depleted in the dusty regions but abundant closer to the star. From the observed SiO maser emission one can in principle derive the (variable) velocity structure of the inner CE.

Until recently, SiO maser emission had only been observed from stars in the Milky Way. Here we report the first extragalactic detection: this opens the way to study the influence of metallicity on the structure of the inner CE.

In May 1995, new, more sensitive receivers were installed at the 15 m Swedish-ESO Sub-millimeter Telescope (SEST) at La Silla, greatly increasing its sensitivity. Shortly after the installation, we performed a search for SiO J=2-1 v=1 maser emission at 86 GHz by pointed observations aimed at a few cool evolved stars in the LMC that were expected to be good candidates for detection. As a first result we detected SiO maser emission from the best candidate amongst them, viz. the RSG PSC04553–6825. This star has thereby become the first known extra-galactic SiO maser.

The performance of the new 3 mm SIS receiver in combination with good atmospheric conditions resulted in a system temperature at 86 GHz of $T_{sys} \sim$ 120 K for elevations above 40°, and about 150 K at an elevation of 20°. After an on-source integration time of nearly 10 hours, corresponding to a total observing time of 26 hours we reached noise level of 63 mJy. We detected a feature at the expected wavelength, with a peak flux of 280 mJy. The line was resolved in velocity: the integrated emission profile reached a significance of 7 sigma (Fig. 1).

The SiO maser emission intensity from PSC04553–6825 is compatible with the observed ranges in SiO maser emission intensities from Milky Way RSGs. Compared to these, the total photon flux (assuming spherical symetry) is low but not extremely so. Some stellar properties (notably the long pulsation period of 930 days and the large volume of the inner CE) of PSC04553–6825 led to the expectation that the SiO maser in PSC04553–6825 could be as bright as the most luminous SiO masers in the Milky Way, but other stellar properties (a low pulsation amplitude) are more compatible with the observed moderate total photon flux emitted by the SiO maser in PSC04553–6825. From our first observations of a very limited sample of stars with one detection, and considering that SiO maser emission is known to be highly variable in both intensity and velocity line profile, we cannot conclude whether SiO maser emission from cool evolved stars in the LMC is different from that from similar Milky Way stars. A systematic difference would not be unexpected given the low metallicity of the LMC.

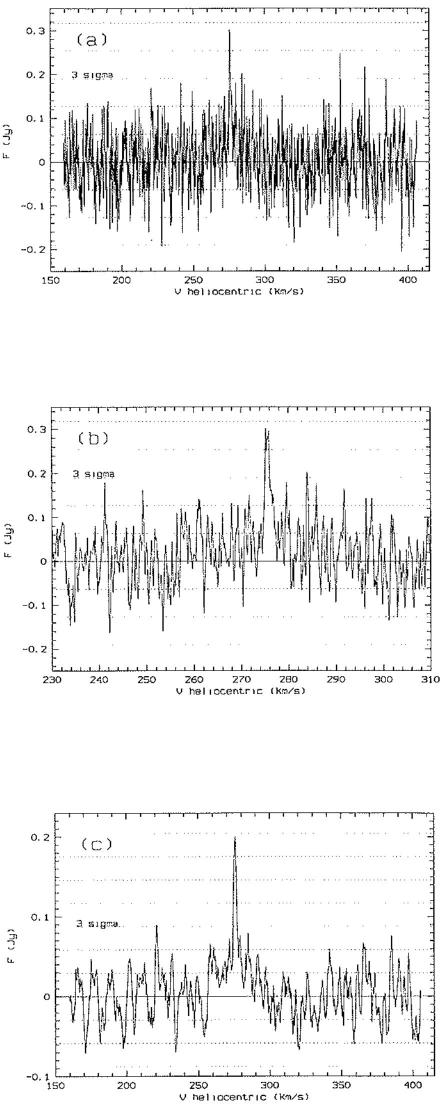

Figure 1: *(a) High resolution (HRS) spectrum around the* $SiO(2\text{-}1)_{\nu=1}$ *maser emission from PSC04553–6825. The velocities are heliocentric, and horizontal dotted lines are given per 1* σ *(1* σ *= 63 mJy). (b) Expanded section of the original HRS spectrum around the maser peak. (c) The HRS spectrum smoothed by averaging over 15 channels (=2.25 km* s^{-1}*). Now 1* σ *= 29 mJy.*

Now that the observational capabilities have improved so much, we can raise the question whether it has become feasible to perform a comparison study of the SiO maser properties of cool evolved stars in and out of the Milky Way. It is clear that such a study would have to be limited to the nearby dwarf companions of the Milky Way. The brightest SiO maser emitters are the RSGs, and amongst the dwarf companions they are only present in the Magellanic Clouds. There are more than a dozen RSGs known in the LMC, which means that it is in principle possible to do a comparison of the SiO maser emission from those LMC RSGs and Milky Way RSGs. Taking the SiO maser emission from PSC04553–6825 as typical for LMC RSGs would mean that with a dozen stars and a full day of observing time per star it is possible to do a survey of SiO maser emission from cool evolved stars in the LMC that is sufficiently sensitive that non-detections bear flux upper limits that are lower than the average flux levels of detected Milky Way RSGs. This type of investigation will take on the order of two weeks observing time.

Extending such a study to AGB stars is more difficult. Average levels of detection for Milky Way AGB stars are such that we would expect to detect only the brightest SiO maser emitters amongst them at the distance of the Magellanic Clouds. Although such detections would yield important data for the study of individual stars, it would be difficult to use the non-detections for a comparison study.

In the near(?) future the study of the SiO maser emission from extra-galactic AGB stars could become easier. With the advent of millimeter arrays in the beginning of the next century the contrast between point source and sky will improve considerably, as well as the collecting area of the telescope. This will certainly yield a major breakthrough in the search for SiO masers in the Magellanic Clouds and perhaps some of the other dwarf companions of the Milky Way as well. It will then become possible to perform a statistical study of the properties of the SiO masers under different environmental conditions, to determine the metallicity dependence of the processes that take place in the inner CEs of cool evolved stars.

Another possibility would be to use the SiO J=1-0 v=1 maser line at 43 GHz which can be stronger by a factor of a few (sometimes even more than an order of magnitude) compared to the 86 GHz maser line. The relative strength of the 43 Ghz versus the 86 GHz line depends on the mass-loss rate and is an important additional parameter. At the moment. In the southern hemisphere only Parkes offers an (old) 43 GHz receiver. If such a receiver were available on the SEST, of comparable quality to the presently available receivers, together with the very good quality of the mirror shape and the La Silla site it would improve the SEST further as a unique facility for extra-galactic SiO maser research.

The ESO Web at 21 Months

FIONN MURTAGH, ST-ECF

Some Current Trends

"A topic which seems to be of interest for astronomy – and we should be cognizant of it – is the World-Wide Web. It is based on hypertext which has been actively discussed for years[1]." "Agreed – even though is it clearly not as important as Gopher or WAIS."

Thus ran part of a conversation during the preparation of a volume on astronomical information retrieval[2] in July 1992. An overview of WWW was obtained, although the likelihood of the subsequent take-off of this information distribution mechanism was not apparent at that time. Certainly, other network-based systems such as Gopher had a far higher profile. Then in mid-1993, NCSA's Mosaic browser came along, which altered the balance of forces between these information resource access mechanisms. In the summer of 1993, the ST-ECF set up a WWW server. ESO's Web server was set up some time later, following a meeting in February 1994.

A lot has changed since then. Now, someone accesses the ESO Web once every 12 seconds on average throughout the 24 hours of the day (November 1995 figure). Accesses have approximately doubled from June 1995. This does not include the Archive, ST-ECF, or La Silla Web servers which contribute numerous additional accesses. The rate of increase of ESO Web usage is at the time of writing around 400% per year (in terms of accesses/hour).

Users of ESO's Web are European to the tune of around 85%. The most numerous users are local (eso.org) – about 16% – and German (.de addresses) – currently around 12%.

Users have become more sophisticated: a count[3] of the number of different browsers used in accessing ESO yielded 49. Versions of Netscape and Mosaic were in the clear majority, roughly sharing the spoils in the ratio of 2:1.

[1]E.g. Adorf, 1989.

[2]Heck and Murtagh, 1993.

[3]B. Pirenne, figure based on Archive accesses using WDB in mid-July 1995.

[4]See McGrath et al., 1994.

[5]Barton and Wedekind, 1995, describe developments at the UN.

Web browsers, servers and accompanying tool-kits are still very often freely and publicly available, which has no doubt helped to advance the area. A useful review of what we can expect in the near future (e.g. the features to be supported by version 3.0 of the HTML language, or current directions in regard to security) can be found in the July 1995 issue of Byte magazine. It was mentioned above how WAIS, among other mechanisms, was more widely used in mid to late 1992. It is interesting to speculate that WAIS is an inherently more marketable and commercializable product.

Phases of Evolution

WWW is a means of communication. Different phases become more popular, more quickly. It is rather like any other communication mechanism, when first faltering steps lead later to greater confidence and ambitiousness. In the case of ESO, the following rough stages can be distinguished.

Phase 1: External information.

Although touted as a new marketplace, so far the Web has remained in large measure a very large number of shop-windows. Its multimedia support has allowed it to excel at presentation of organisations and groups. Public relations information, details of meetings and conferences, established observing schedules, archive and database access mechanisms, visitor and weather information – these have been extensively and continuously used. A big upgrade of the La Silla Web area was recently carried out (and the Garching server is continually undergoing shifts of orientation and layout).

Phase 2: Internal information.

Here we are mainly interested in the organisation's openly-accessible information, relating to the organisations's products and major activities – in our case, the provision of observing services. The open information product in this case is accurate and comprehensive instrumentation description and news.

Instrumentation information is available to the user in the following ways: (a) ESO's call for proposals booklet; (b) operating manuals, mostly in hard-copy, and not always up to date; (c) articles in the Messenger; (d) personal contact of course; and (e) the Web. The latter has recently seen major new areas created for the NTT, and Optical Detectors.

The basis for this work on information dissemination[4] has one considerable advantage: the target environment is identified. The Web offers too many advantages, especially in a scientific environment, to allow for any realistic alternative. It is also now seen as the primary information distribution mechanism for internal as well as external communication, not least because of its multi-platform support.[5]

However, the detailed planning of the development of this information systems environment requires substantially more thought. This is due to a well-known fact: it is very simple to set up information on the Web, but it can be very difficult to ensure longer-term maintenance. Long-term support of ESO's instrumentation information requires a systems approach. A plan for integrating, developing and maintaining this information system is currently being drafted.

The most important activities in mid-1995 in regard to the ESO Web were in the area of telescope, instrumentation and detector information. The results of this work are now to hand.

Phases 3 and 4: Electronic publishing; and Interactive data analysis.

The effectiveness of the Web, through a personal home area or otherwise, for providing an overview of a research field, with preprints and information on publications, is quite remarkable. It is surprising that this communication resource is not used more at present. In some cases – when properly planned and executed of course – Web-delivered preprints attract a greater readership than the eventual publication. Such an opportunity is all the more attractive insofar as these are complementary and mutually-supporting ways of getting the message across.

Regarding interactive data analysis, the Web has been somewhat passive to date, but new browsers will make it considerably more interactive. The possibilities for interaction with data using the

HotJava browser, among others, offer new prospects and challenges for the communication of ideas. Various projects are quite advanced, which will allow image processing, symbolic mathematical manipulation, and other data treatments to be dealt with purely in the Web environment.

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The ESO STC in Times of Change

J. ANDERSEN, Chairman, ESO Scientific Technical Committee

The Role of the STC

The charge of the ESO Scientific Technical Committee (STC) is to advise the ESO Council on "... policy matters of long-range scientific and technical importance ...". It consists of 12–16 members appointed "... for their scientific and technical eminence, with at least one member from each Member State ..." (plus observers from Portugal and Chile, pending their full STC membership).

Four years ago, the writer found himself appointed to this august body. And three years ago, the then Director General asked if I would accept a nomination to chair the STC, the extra workload estimated to be about two days per year.

As 1995 draws to a close under a new Director General, a quick status shows that neither ESO, the STC, nor its chairman look much like we did then. One thing has remained constant, however: Chairmanship of the STC is limited to three years. As my term thus comes to an end, the Editor has asked me to summarise my impressions of life in the STC for the readers of The Messenger.

The STC's Modus Operandi

As I joined the STC, veteran members discreetly aired a certain frustration that meetings were somewhat formal affairs and the communication mostly one-way. Not known for letting tact get in the way of change – and with the active encouragement and support of the new ESO Management – I have tried to modify certain aspects of the STC's working modes and style.

First, new Terms of Reference have been approved by Council, which clarify the role of the STC as dealing with general policy matters, as a two-way information channel between ESO and its community, and also the relative roles of the STC and the Users Committee (UC). The STC can now have 12-16 members, so new ESO members or scientific fields can be quickly accommodated. And terms are now for three years (renewable once) rather than the previous fixed five-year terms, also in the interest of flexibility.

The STC also equipped itself with a Vice Chairman, elected annually by the STC itself to replace the regular chairman as needed; Klaas de Boer, Bruno Marano, and Andre Blecha were elected in 1993-95.

At the meetings, the previous lengthy oral status reports by the ESO staff have been replaced by "fact sheets" sent out in advance (a "sheet" is a piece of paper with no more than two sides!), time at the meetings being devoted to two-way discussions. And each day starts and ends with a half-hour informal session (STC members only) where potential problems or misunderstandings can be identified and prevented, resolutions drafted and/or modified, etc.

It is not for the writer to judge whether efficiency has improved. But the consensus seems to be that the meetings have at least become rather more lively, culminating in the May 1995 meeting in the magnificent Council Room at Observatoire de Paris, with a subsequent visit to REOSC and a first live glimpse of the 8.2-m VLT primary mirrors.

Contact to other ESO Bodies

The STC's direct reference is to the Council, and the STC chairman is invited to attend its meetings. During my term, Council has expanded the scope of the debates at which the STC chairman is present to include matters of such direct scientific impact as, e.g., the future of ESO in Chile. I am glad to convey the STC's appreciation of this sign of Council's confidence in its main advisory committee.

In order to improve coordination with the UC and minimise the work of the ESO staff in preparing the meetings, the UC Chairman now has a standing invitation to attend the STC meetings. Similar mutual invitations between the STC and the Finance Committee were suggested by certain humorous souls, but might be too much of a cultural shock for both sides... Still, I hope the STC has been able to provide useful technical advice on some of the major contract decisions in the VLT project (see, e.g., The Messenger 81, 3).

Finally, the STC has invited all the ESO committees and the astronomical members of Council for the discussion in November 1995 of the long-term plans for La Silla (see below). I hope very much that discussing such a long-term policy issue in this broad and representative forum will have been found useful.

Planning for the VLT

The first task for the new Director General in early 1993 was to re-establish a realistic schedule for the VLT project and re-structure ESO to carry out the project according to that plan. The magnitude of this task was well illustrated by the 1994 Audit Team: While the LEP project corresponded to three annual CERN budgets, the VLT is equivalent to five annual ESO budgets. As the corresponding refurbishment of the ESO structure proceeded, part of the task of continuing the long-term scientific planning fell, appropriately, to the STC.

The previous concept of having the four VLT telescopes in place almost simultaneously, complete with instruments, avoided the need to discuss priorities. With the new schedule, this was no longer possible. Hence, the STC appointed a Working Group on Scientific Priorities for the VLT Observatory, ably chaired by Dr. L. Vigroux, to reconsider the most urgent science to be done with the VLT.

One of their initiatives was the first of what is now a series of ESO Workshops, „Science with the VLT". Their report, issued on that background, was unanimously endorsed by the STC. The STC - indeed all of us – owe Dr. Vigroux and colleagues our cordial thanks for their efforts and dedication in placing the VLT planning on a firm scientific basis.

Planning for VLT Instrumentation

With a VLT construction period extending beyond the year 2000, it was clear that the instrumentation plans defined in 1988-89 needed review and updating. The Vigroux committee addressed also this question as a corollary of their high-level review. As a result, certain adjustments of the existing plans were made, and new instruments for an ambitious push at the frontiers of modern cosmology are now under active study by several groups.

As part of this move, the STC was gratified by ESO's decision to launch an aggressive programme in the field of optical detectors, with the prospect of ESO becoming a leader in the field within a short time.

Planning for La Silla (I)

Already in late 1992, it had become clear that the ESO staff was overcommitted with the multitude of tasks at hand, and that a review of scientific priorities for La Silla operations was needed. A Working Group was appointed to this task and issued a set of recommendations that were later approved by the STC and Council (see The Messenger 74, 29) and are now being implemented.

These recommendations have been seen by some as discriminating blindly against small telescopes. This is a misunderstanding: Much valid science can be done with small telescopes, hopefully including some perpetrated by the present writer. But it does not necessarily follow that any instrument of any size and age must continue to run forever, regardless of cost and – yes, sorry – quality of the science.

In actual fact, those instruments able to prove their worth are happily continuing operation, if perhaps under different boundary conditions, while others are making way for new, more exciting science (see, e.g., The Messenger 81, p. 10).

One, to me, unexpected result of this first planning exercise was the extent to which the actual cost of running La Silla was independent of the scientific facilities actually offered. This meant that efforts by management to contain costs were less dependent on the details of the scientific planning than on the organizational setup, a useful lesson for the following exercise.

Planning for La Silla (II)

While the first review of La Silla operations was mostly in the nature of urgent firefighting, thought also needs to be given to the long-term role of La Silla in the VLT era. The Working Group set up for this task, and the rationale for its work, have been described in these pages (The Messenger 78, 3, and 80, 4). At the time of writing, its recommendations are being finalised for joint review by the ESO committees as noted above.

One aspect of this planning for the future was to identify the needs for new powerful instruments for La Silla. E.g., an ambitious near-infrared imager and spectrometer (SOFI) to go on the NTT after the „Big Bang" has already been approved. Another aspect, however, is to rank the facilities in order of importance for the future scientific productivity of ESO as a whole, given the financial constraints and the need to concentrate on keeping ESO's top-rank instruments competitive. Identifying the facilities that must survive will involve choices that will be felt as unpleasant by many.

Yet, at a time when the price of the VLT has gone up, however modestly compared to e.g. typical space projects, and the demands on those who fund us are multiplying, it will be deadly to our credibility if we cannot decide which of our wishes are more or less important. Decisions will be taken whether we like them or not; if we want to be able to guide them, there is homework to be done, also by the astronomers.

Epilogue

These three years on the STC, at the interface between colleagues keen to pursue front-line science and beleaguered administrators forced to keep costs under control, have been a fascinating and busy time.

Becoming a bit philosophical at the end is probably a sign of old age. But I have come to regard committee chairmen as disposable commodities, perhaps a bit similar to paper towels: One serves for a while, picks up some of the dirt, hopefully leaves a clean slate, is replaced by a fresh one, and life goes on.

In conclusion, I wish to offer my thanks to all colleagues on the staff, Council, and committees of ESO for their excellent cooperation under sometimes difficult conditions, and for bearing with my initial inexperience – and occasional impatience.

News and Views from the Users Committee

M. DENNEFELD, Chairman of the UC
Institut d'Astrophysique de Paris (IAP) and Universite Pierre et Marie Curie (Paris 6)

The structure and function of the Users Committee (UC) have been defined as early as 1978 and are adequately described in a previous article about the UC by B. Marano (The Messenger, 55, March 1989). UC is composed of one representative per member country, to which have been added recently an observer from Australia (pending Australia's expected membership) and a Chilean observer who will become a full member as soon as the updated agreement between ESO and Chile has been ratified by both parties. UC is therefore a group of people with various scientific and cultural interests, and it is exciting to see that always more countries are keen to join ESO's venture.

The Terms of Reference of the UC state that its task is: "to advise the Director General (DG) on matters pertaining to the functioning of the La Silla observatory from the point of view of the Visiting Astronomers". The practical interpretation of this statement has, however, evolved significantly during my term as Chairman of the UC. This is due to the convergence of several facts: the emergence of the VLT which drives a redefinition of the role of La Silla; the multiplication of instruments and telescopes which has stretched the requirements on technical staff to their limits; the financial situation which translates into a decreased budget for La Silla; the energetic impetus of a new DG; and, last but not least, the dedicated work of the UC members, backed up by their community. As a consequence, the single, annual UC meeting has now a heavy agenda, spreading over two days and dealing with matters ranging far beyond the simple "functioning" of the La Silla observatory. This also has consequences for the working procedure.

Working Method, and Program

The meeting is opened, naturally, by a presentation of ESO's global situation and perspectives by the DG. This report sets the tone of the meeting, and presents the boundaries which limit the possibilities to satisfy all the users' wishes! For instance, a recent announcement that the La Silla budget had to be reduced by about 30% was of course not received with pleasure, and gave to the UC the opportunity to express its unanimous opinion that the La Silla observing facilities should be the last place to make cuts, at least until the VLT is fully operational. This, however, is not incompatible with optimising the observing schedules, avoiding too much instrument duplication and change-overs, keeping front-line instrumentation only and yet still achieving some savings.

These "higher-level" preoccupations explain why the UC cannot confine itself to the simple functioning of existing instruments ("care about the missing screws", as a previous DG had put it...). This everyday functioning remains however an important item on the agenda, but is treated differently. With one annual meeeting, it does not make much sense to report about individual malfunctionings which happened in some cases many months before. These problems should be solved rapidly on the mountain, if the observing report has been filled in adequately. Instead, while still checking that the problem has been solved, the UC members look to see if it has been repetitive, if it reveals an error in the procedure, or if more fundamental changes in the telescope or instrument are required. And, to avoid unnecessary repetition of the same problem by each national representative, such items are identified beforehand and presented globally. This preparation is done during an informal working evening, the day before the official UC meeting; this gathering of UC members has proven to be very useful and has now become traditional. On ESO's side, the presentations by the various heads of departments: La Silla TRS (Technical support) and ASD (Astronomy Department), Visiting Astronomers section, Data Management Division, Instrumentation Division, etc.. have been reduced. But the essence of the news has been condensed into so-called "fact-sheets" which prepare the meeting, as they are (and only if they are) generally distributed well ahead of the meeting. The discussion can then concentrate on those items which need clarification, which are new or need long-term action. This does not mean that smaller problems are supposed to solve themselves: the UC members always keep an eye open (and hopefully two!), but it is better that we spend our time proportionally to the importance of the item, isn't it?

For instance, one of the major questions discussed in several recent meetings is the quality of the detectors at La Silla. The question was twofold. On one hand, a non-linearity problem was discovered in some CCD's, thanks to a through analysis by several groups of astronomers, particularly at the Observatoire de Liege. The problem, due to some type of controllers, has been solved by now and a partial account published (Schwarz and Abbott, The Messenger, 71, 1993). But we still need to know exactly which data, over which period of time, were concerned, as this obviously might affect the quality of some of the scientific results. There is always a danger (as happened in the past with the IDS) that, as time passes, one simply forgets to complete the analysis because, of course, future data will not be affected anymore. With the rapid development of data banks, however, a quality flag will be mandatory on all data! On the other hand, there was the growing concern that the detectors available at the observatory (especially for the CCD's) were not at the level (size, read-out noise, read-out speed, response in the blue, etc..) required and that this was a serious limitation for the competitiveness of the observatory. Such a problem is of course far reaching (much further than the modest UC..), could also affect the VLT, and required a long-term action. Thanks to a collective effort at ESO, and taking into account views from the UC, STC, and from a specially appointed external review panel, an energetic development program is now under way, under the responsibility of J. Beletic, which should bring ESO to the forefront in the near future.

Another subject of discussion was the restructuring in Chile, with the move to Santiago of part of the activities previously taking place in La Silla. The reasons for this move, approved by Council, had to do with the saturation of the housing facilities on the mountain, the development of the Paranal site and the difficulties of managing two sites from another place than Santiago, the need to develop better scientific links with the Chilean astronomical community, the quality of life of the ESO staff, etc.. The UC was concerned that this move could have negative consequences on the quality and quantity of the support to the Visiting Astronomers on the mountain (availability of the astronomers and engineers with the specialty corresponding to the instruments in use, computing power, size of the library, etc...). Assurances were given that no difference should be noticed by the Visiting Atronomers. At the moment, some reduction in off-line computing facilities is still noticeable on the mountain, but the move is recent and we are still in a transitory period which should come to an end soon.

Influence of the VLT on La Silla

These few examples show that the shadow of the VLT is growing on La Silla and thus the UC cannot valuably discuss about telescopes and instruments in La Silla without taking into account the perspectives (and needs) opened by the VLT. An update on VLT and VLT instrumentation developments is therefore now regularly given to the UC. Similarly, the need to prepare for and discuss the new modes of operations, necessary to achieve an efficient use of the VLT, is felt more strongly every day. The operation's plan for the VLT is still in a draft form, but has already led to interesting (and lively!) discussions on the pro's and con's of service observing (like for Space Instrumentation) versus more traditional observing with the presence of the astronomer on the site. While the discussion is far from being closed, an interesting notion has already emerged: the distinction between guaranteed results (in service mode) and guaranteed time (in the classical mode, without compensation for weather losses or instrumentation failures). It is nevertheless clear that a transition period will be necessary, where the astronomers will have an important role of evaluation, until a VLT instrument is fully operational, and in principle ready for service mode. As these modes of operation are fundamentally new for most ground based astronomers, the question has been raised by the UC to test the VLT operation model before it is implemented on the VLT directly. Such a test will be possible on the NTT in the near future. As everybody knows, the NTT is presently in a large refurbishing period, (including a so-called "Big Bang" with interruption of observations) driven both by some remaining problems (repeatedly pointed out by the UC) and the need to have it really work as a test bench for the VLT, also from the point of view of the active optics. This implies replacing various pieces of electronic and computer hardware, as well as software, to have it fully compatible with VLT. When this is done, at the end of 1996, after the "Big Bang" (whose timescale will hopefully become shorter and shorter, as in reality?), several of the VLT operational aspects will be tested directly and will provide at the same time a very efficient way of operating the NTT itself.

Another aspect of the benefits of the VLT program for La Silla is shown by the question of IR spectroscopy. The UC has recently strongly emphasized that the development of IR astronomy over the world required a corresponding effort from ESO to remain competitive. While IR imaging facilities have grown to an acceptable level in recent times, IR spectroscopy still relies on IRSPEC: although a champion in some respects at its time, this instrument does not compare favourably anymore with other systems equipped with more modern, larger arrays. The problem is further enhanced by the NTT upgrade, which would require, once completed, a corresponding upgrade on IRSPEC to remain compatible: such an effort is not judged worthwhile for such an old instrument. The pressure from the UC, relayed by the STC and by ESO staff, has led to the decision to copy the near IR spectro-imager (ISAAC) foreseen on UT1 of the VLT to provide a modern, forefront IR instrument, called SOFI, on the NTT. Favourable circumstances make it even possible to have SOFI ready before ISAAC, and with some additional possibilities! The only concern now is about the transition period, between the overhaul at the NTT, requiring a stop of observations (thus of IRSPEC) starting on July 1st, 1996, and the arrival of SOFI later in 1997: this period corresponds to the expected first results from the ISO satellite! ESO is presently looking into alternative ways to give its astronomers access to IR ground based spectroscopy during this exciting period.

The future of La Silla

With the VLT approaching, and the global financial constraints imposed by Council to ESO, the "streamlining" of La Silla has been a constant preoccupation over the last years. The recommendations were prepared by two successive Working Groups (both chaired by J. Andersen, from Copenhagen) both dealing with "Scientific Priorities for La Silla", for final approval by STC and Council. The UC was associated with this work, with one member in the first WG and two in the second one (three in the next one?), and the draft reports were extensively discussed during the UC meetings. Results from the first WG are now widely known (see J. Andersen, in The Messenger, 74, December 1993) and are implemented. The second WG, dealing more specifically with the role La Silla should have in the VLT era, is still working, but an interim report is already under discussion. The community is widely consulted, through an initial questionnaire (see The Messenger, 78, December 1994), and thanks to the work of the UC members which collect the feed-back to the interim report. Discussions are lively within the UC itself, as users would globally like to keep all the facilities, and, of course, add new ones (and obviously somebody has to apply the brakes!), but reasonable agreement emerges on the main characteristics an ideal observatory should have. An account on the final report will certainly appear in a forthcoming issue of The Messenger, but the main lines for La Silla are already emerging: concentrate on the complementarity between the two sets of telescopes and on the modes the VLT cannot easily achieve (long-term monitoring, wide-field imaging or spectroscopy, etc...); reduce functional costs and working load by minimizing change-overs (including top-units changes); tend towards a specialisation of telescopes and reduce duplicate instruments; look for additional resources by the loan of some smaller telescopes to interested groups for long-term programmes; (do you remember the time (1968) when the ESO directorate announced: "observing periods granted may range from several weeks to several months..."?); but keep the global observing possibilities by retiring an instrument from La Silla only when and if a corresponding one is commissioned on the VLT; etc... The idea is now accepted that not everything can be done with the VLT and that a set of telescopes with various diameters and instruments is necessary to conduct coherent scientific programs. How many is another question... the times are here where some cuts will also be necessary! This is however an evolving situation, with the prospect that new countries joining ESO will bring new interests and allow new developments, so that this type of work and analysis will be a continuous process over the coming years.

The future role of the UC

It is therefore obvious from the above that La Silla cannot be discussed in isolation anymore. Although we, at the UC, do not always have the global view, particularly on the financial constraints pertaining to the mountain, our discussions are evolving within a framework which resembles more and more the one of the STC. This is not surprising, and happened naturally during the past years when the workload of the STC (and the main objectives of ESO) were more focused towards the VLT. The situation is also new with the existence of two sites instead of one as previously, and the need to think about a new structure for La Silla. There is however also a more fundamental difference between the UC and the STC: the former reports to the DG, while the latter reports to Council. Such a dichotomy is not usual in other major observatories. It further raises the question on how the opinions and wishes of the users are channeled to STC and Council, to help them make their decisions. Because UC members, as part of their duty, regularly consult the community of users, they are in an excellent position to relay their opinion. A step forward has been achieved by inviting the chairman of the UC to participate in STC meetings, where he can present the views of the UC. The exchange of information is actually favoured by the excellent relations between the chairmen of both committees, but should be formalised for the future. Part of the exchange of information also has to take place at national level. I found extremely useful in the past years the organisation, during regular meetings of our national astronomical society, of an open session devoted to the questions relevant to ESO, where the users and the national representatives in the various ESO committees could give and gather the necessary information. It seems to me fundamental that in the present, difficult times, one finds the largest possible adhesion to the decisions which have to be made. For the very fundamental questions, like the future of La Silla, an elegant solution will be implemented for the first time at the end of this year: a joint meeting with all astronomers from ESO committees (Council, STC, OPC, UC) will discuss the report of the last WG. This replaces a Users' conference (which could be called by the UC, but was difficult to organise, especially at short notice), but provides nevertheless a large and representative sample of opinions. For less fundamental questions, one still has to rely on the work of UC members and the good will of the others. It is a long time since the first "meeting of users" could be called in the office of the Director General (A. Blauuw, ESO's early history, p.133)...

Only a few points could be adressed here, but many more are discussed during UC meetings!: for instance the seeing and pointing at the 3.60 m, the status and performances of IR instrumentation at the 2.2 m, the need for a direct, CCD camera at the 1.54 Danish, the importance of a new, bright-time instrument at the ESO 1.52 m, the usefulness of small telescopes, etc... The minutes are correspondingly more voluminous. But also they are so because they should give a detailed account of what is being discussed. Because they are widely distributed, they form, with all the attached documents summarizing the activities of the various ESO divisions, a unique channel to circulate information between ESO and the astronomers. As such, they complement very well The Messenger. But the UC can only continue to play its role, maintain the link and help ESO to stay at the forefront of research if the community is providing the feedback, with constructive criticism and new ideas: in other words, if the users really care about what is happening in THEIR observatory.

The current composition of the UC is given in The Messenger, n.79, p.40, March 1995.

ANNOUNCEMENTS

1st ANNOUNCEMENT

ESO Workshop on

"THE EARLY UNIVERSE WITH THE VLT"

European Southern Observatory,
Garching b. München, Germany
1–4 April, 1996

TOPICS

- The VLT first generation instrument capabilities as cosmological tools.
- Galaxy evolution at redshift z<1 - redshift surveys, imaging with the HST, two-dimension spectroscopy.
- Evolution of large-scale structures - redshift surveys, gravitational lensing and shear, large-scale structures at high redshift.
- Search for high redshift faint galaxies - redshift surveys, identification of quasar absorbers, search for primeval galaxies, simulations of galaxy formation.
- Evolution of active objects - high redshift radio and starburst galaxies, prospects for ISO deep surveys, search for very high redshift quasars.
- Which second generation VLT instrumentation?

Many of these topics are being covered by invited talks, but a limited number of contributed talks will be accepted, as well as poster papers.

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ESO Workshop on

SCIENCE WITH THE VLT INTERFEROMETER

Garching bei München, Germany
June 18 – June 21, 1996

Each session will consist of reviews by invited speakers followed by contributed talks. Poster contributions are encouraged. Technical contributions will be limited to posters.

There will be tutorials on interferometric techniques during the meeting.

Scientific sessions will include:

- Solar system
- Extra-solar planets and planet formation
- Low mass stars and Brown Dwarfs
- Star formation and early stellar evolution
- Binary stars and multiple systems
- Stellar surface structure
- Circumstellar environments and mass loss
- Galactic nuclei and AGN

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CNRS – Observatoire de Haute-Provence
and
European Southern Observatory

5th ESO/OHP Summer School in Astrophysical Observations

Observatoire de Haute-Provence, France,
15-26 July 1996

The ESO/OHP Summer School offers young astronomers the opportunity to gain practical observing experience under realistic conditions. Participants will work in groups of three and will be guided by an experienced observer in the use the instrumentation of the OHP. Each group will carry out a small observing programme on the telescopes of 1.2–1.9m aperture (direct imaging and spectroscopy, both of which are equipped with a CCD detector), and reduce the data with a modern image processing system (MIDAS and IHAP). The results will be related to relevant additional information from the astronomical literature, and presented in a brief summary to the other participants at the end of the school.

The preparation of the practical work will be supplemented by a series of 90-minute lectures which will be given by invited specialists. Foreseen subjects include: (a) Modern Telescope Layout, (b) Detectors, (c) Optical instrument design, (d) Principles of Photometry, (e) Spectrographs and spectroscopy, (f) Optical Instrumentation Fundamentals and (g) Data reduction techniques. A scientific talk on a frontier astronomical subject is also foreseen.

The working language at the summer school will be English. Applications are invited from graduate students working on a Ph.D. thesis in astronomy at an institute in one of the ESO member countries. Application forms are available from the organizers and are to be returned by March 31st, 1996. Additionally, a letter of recommendation by a senior scientist familiar with the applicant's work is required. Up to eighteen participants will be selected and will have their travel and living expenses fully covered by the school.

THE ORGANIZERS:

M.P. Véron Observatoire de Haute-Provence F-04870 Saint-Michel-l'Observatoire France	P. Crane European Southern Observatory Karl-Schwarzschild-Str. 2 D-85748 Garching Germany
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Proposed Timetable of Council Sessions and Committee Meetings 1996

(subject to Council approval)

February 6	Finance Committee (extraord.)
April 29–30	Users Committee
May 2–3	Scientific Technical Committee
May 6–7	Finance Committee
May 29–31	Observing Programmes Committee
June 4–5	Council
October 30–31	Scientific Technical Committee
November 5–6	Finance Committee
November 27–29	Observing Programmes Committee
December 3–4	Council

Jan Hendrik Bannier 1909–1995

We received the sad news of the death on 7 September of Dr. Jan Hendrik Bannier.

Dr. Bannier was one of the founding fathers of CERN and of ESO. Through his personality and his influence at an international level he contributed decisively to the establishment of ESO.

From 1964 to 1968 he served as Chairman of the ESO Finance Committee and from 1969 to 1971 was President of Council. He contributed to the smooth development in the early phase of the organisation, always taking a deep personal interest in all scientific, technical and administrative matters.

His name is associated with the "Bannier Procedure", still the basis of the budgetary and financial planning in CERN and ESO.

We will always remember him and his contributions to our organisation.

PERSONNEL MOVEMENTS

International Staff (1 October – 31 December 1995)

ARRIVALS

Europe

HÜDEPOHL, Gerhard (D), Electronical Engineer
EISENHUTH, Dorothea (D), Secretary to the DG
WOLTERS, Otto (NL), Accounts Clerk
CUMANI, Claudio (I), Software Engineer
(changed from Paid Associate to Int'l Staff Member)
DE MARCHI, Guido (I), Fellow
COMÉRON, Fernando (E), Fellow
RANDICH, Sofia (I), Fellow
LE LOUARN, Miska (F), Student

Chile

STORM, Jesper (DK), Astronomer
(changed from Paid
Associate to Int'l Staff Member)
DELGADO, Guillermo (RCH), Microwave Engineer

DEPARTURES

Europe

AITKEN, Baxter (GB), Technical Editor
BUSCHMEIER, Wilhelm (D), Head of Administration
FERRAND, Didier (F), Engineer/ Physicist
MORTENSEN, Lars (DK), Mechanical Engineer
MINNITI, Dante (RA), Fellow
COURBIN, Frédéric (F), Student

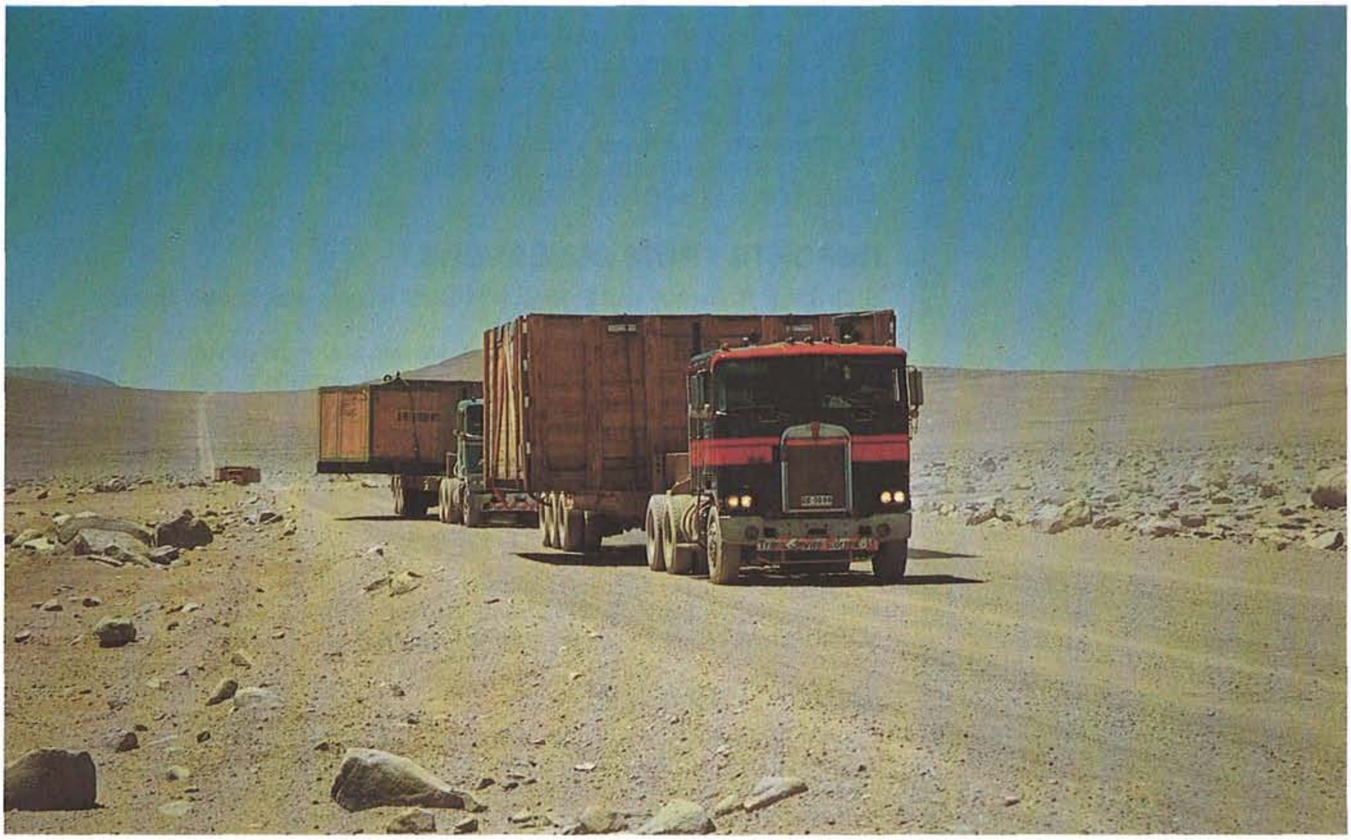
Chile

CHATZICHRISTOU, Eleni (GR), Student
DE BRUIN, Peter (S), Microwave Engineer (SEST)

Local Staff Chile (1 October – 31 December 1995)

DEPARTURES

ARCE, José (RCH), Electromechanic
SANCHEZ, Ariel (RCH), Night Assistant



This figure shows the start of the long and intrepid transport of the 4 rotating platforms of the Coudé station in a 7.5 metre diameter container from Antofagasta harbour to the Paranal Observatory.

ESO, the European Southern Observatory, was created in 1962 to . . . establish and operate an astronomical observatory in the southern hemisphere, equipped with powerful instruments, with the aim of furthering and organising collaboration in astronomy . . . It is supported by eight countries: Belgium, Denmark, France, Germany, Italy, the Netherlands, Sweden and Switzerland. It operates the La Silla observatory in the Atacama desert, 600 km north of Santiago de Chile, at 2,400 m altitude, where fourteen optical telescopes with diameters up to 3.6 m and a 15-m submillimetre radio telescope (SEST) are now in operation. The 3.5-m New Technology Telescope (NTT) became operational in 1990, and a giant telescope (VLT = Very Large Telescope), consisting of four 8-m telescopes (equivalent aperture = 16 m) is under construction. It is being erected on Paranal, a 2,600 m high mountain in northern Chile, approximately 130 km south of Antofagasta. Eight hundred scientists make proposals each year for the use of the telescopes at La Silla. The ESO Headquarters are located in Garching, near Munich, Germany. It is the scientific-technical and administrative centre of ESO where technical development programmes are carried out to provide the La Silla observatory with the most advanced instruments. There are also extensive facilities which enable the scientists to analyse their data. In Europe ESO employs about 200 international Staff members, Fellows and Associates; at La Silla about 50 and, in addition, 150 local Staff members.

The ESO MESSENGER is published four times a year: normally in March, June, September and December. ESO also publishes Conference Proceedings, Preprints, Technical Notes and other material connected to its activities. Press Releases inform the media about particular events. For further information, contact the ESO Information Service at the following address:

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List of Preprints

(September-October 1995)

Scientific Preprints

1102. P. Molaro, S. D'Odorico, A. Fontana, S. Savaglio, G. Vladilo: Chemical abundances in the damped system at z = 3.390 towards QSO 0000-2619. *AA*.
1103. D. Minniti: Kinematics of bulge giants in field F588. *Ap.J.*
1104. L. Kaper, H.F. Henrichs, J.S. Nichols, L.C. Snoek, H. Volten, G.A.A. Zwarthoed: Long- and short-term variability in O-star winds. I. Time series of UV spectra for 10 bright stars. *AA*.
1105. D. Minniti: Field stars and clusters of the galactic bulge: implications for galaxy formation. *Ap.J.*
1106. A.A. Zijlstra, C. Loup, L.B.F.M. Waters, P.A. Whitelock, J.T. van Loon, F. Guglielmo: Obscured AGB stars in the Magellanic Clouds II. Near-infrared and mid-infrared counterparts. *M.N.R.A.S.*
1107. M. Villar-Martin, L. Binette: Ca depletion and the presence of dust in large scale nebulosities in radio-galaxies (I). *AA*.
1108. P. Dubath, B. Reipurth, M. Mayor: Radial and rotational velocities of young stars in Chamaeleon and Lupus. *AA*.
1109. N.S. van der Bliek, B. Gustafsson, K. Eriksson: Stellar far IR fluxes: how accurate are model predictions? *AA*.
1110. S. Stefl, L.A. Balona: Rapid photometric and spectroscopic variability of the Be star DX Eri. *AA*.

Technical Preprint

69. ESO Contributions to the Conference "New Modes of Observing for the Next Century", Hilo, Hawaii, July 6–8, 1995. Astron. Soc. Pacific Conference Series

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