For the manufacture of the very large VLT mirror blanks, Schott uses the spin-casting technique. In the 2400 m^2 production hall on the bank of river Rhine which was specially constructed for the VLT Project, 45 tons of molten glass is poured into a rotating mould with curved bottom; it makes about six revolutions per minute. In this way the blank is given the desired, curved shape which is retained when the glass cools and solidifies.

This prototype blank will spend about three months in an oven while it is slowly cooled to room temperature. Then follows a mechanical correction of the shape and thereafter a renewed thermal treatment, the so-called ceramization process, by which the material achieves its zero-expansion properties, making it insensitive to temperature changes and suited for use in astronomical telescopes.

ESO has congratulated Schott on the successful casting of the first mirror blank of this size. Smaller blanks from Schott of the same material are used in other advanced astronomical instruments like the Keck telescope, ROSAT, Galileo and AXAF.

Flexible Scheduling at the NTT, a New Approach to Astronomical Observations

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The Recent NTT Experience

Already at the time of first light of the NTT on March 23, 1989 (see *The Messenger* No. 56, June 1989), there was the confirmation that the La Silla sky was able to give stellar images of dimension two or three times better than the normal experience. An observation resulting in stellar images with a diameter of 0.33 arcsec contains such a large quantity of information that not all instruments are capable to benefit, unless they are designed for such conditions.

Other characteristics of the NTT have transformed or stopped old traditions of optical astronomers. For example, because the pointing of the NTT is better than 1.3 arcsec rms, in the direct imaging mode there is no need of checking the field before starting the exposure. It is obvious that it will become essential to arrive at the telescope with precise coordinates if the observer wants to make an efficient use of precious telescope time.

The extensive campaign of site testing organized by M. Sarazin was not only beneficial for the exploration of the best site for the VLT observatory, but it resulted also in an undertaking that has given important and new results about the atmospheric properties and their influence on astronomical observations.

We are now confident about the frequency of excellent seeing and we start to understand its time behaviour. The next step is to forecast the expected seeing. We are considering the possibility to install a number of seeing

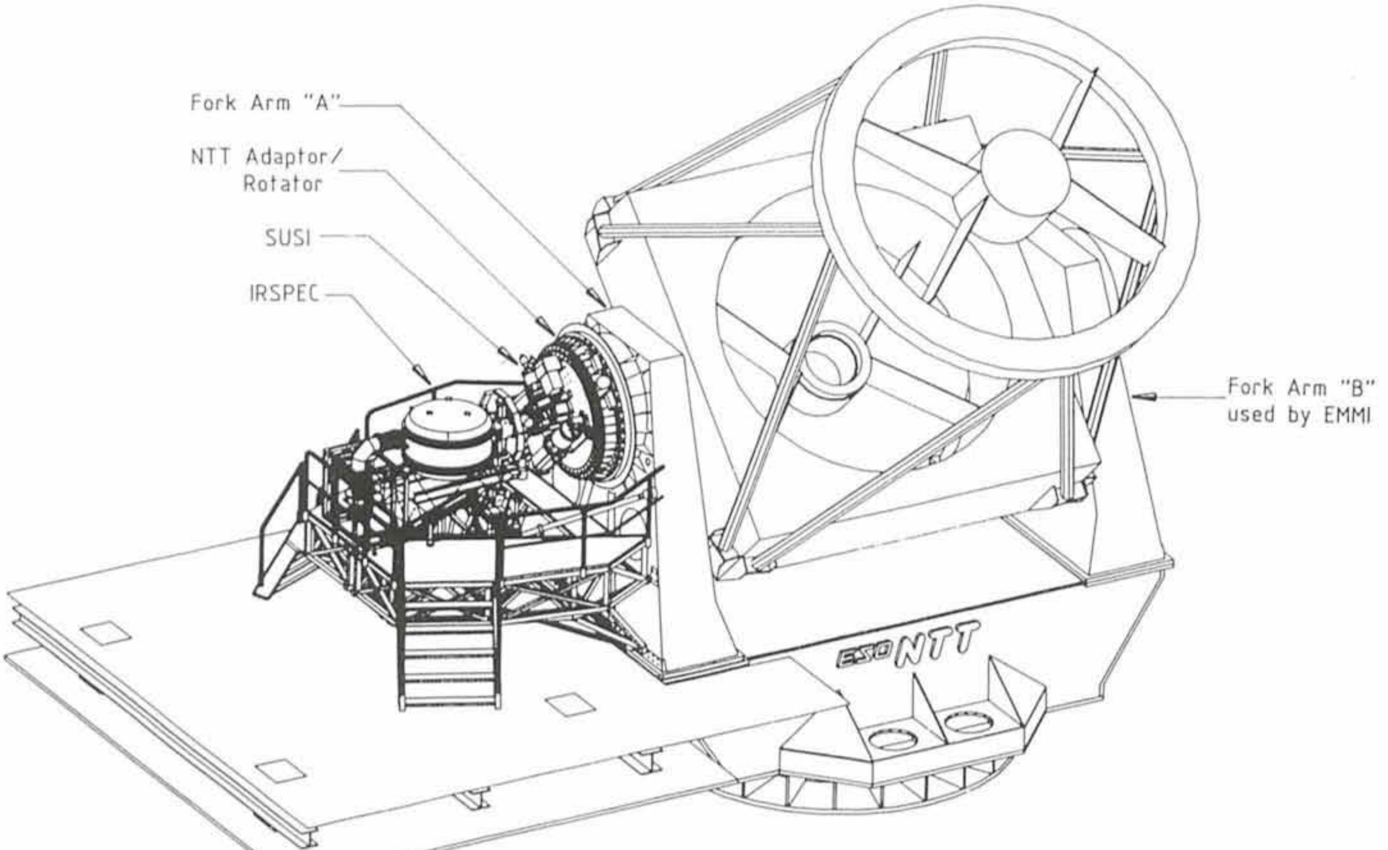

Figure 1: *Schematic layout of the NTT showing the location on Fork Arm "A" of SUSI and IRSPEC.*

monitors in strategic locations to flag the arrival of conditions of superb seeing. From the existing data it is expected that on La Silla the seeing will be less than 0.5 arcsec for about 200 hours per year.

The Need for New Instrumentation

The success of the NTT experience and the rediscovery of the potentiality of La Silla imply the development of a new type of instrumentation tuned to new goals. The two original instruments designed and realized for the NTT: EMMI (the ESO Multi-Mode Instrument) and IRSPEC (the Infrared Spectrometer) are among the most sophisticated and versatile astronomical apparatus ever built. Their complexity and the basic goals of their multi-mode approach imply some limitation on the performances in extreme conditions. It is important to remember that the EMMI project started in November 1985, the IRSPEC one being even older. At that time the seeing limits attainable were not established. ESO has immediately grasped the importance of the situation and started forthwith the design of new instruments such as SUSI.

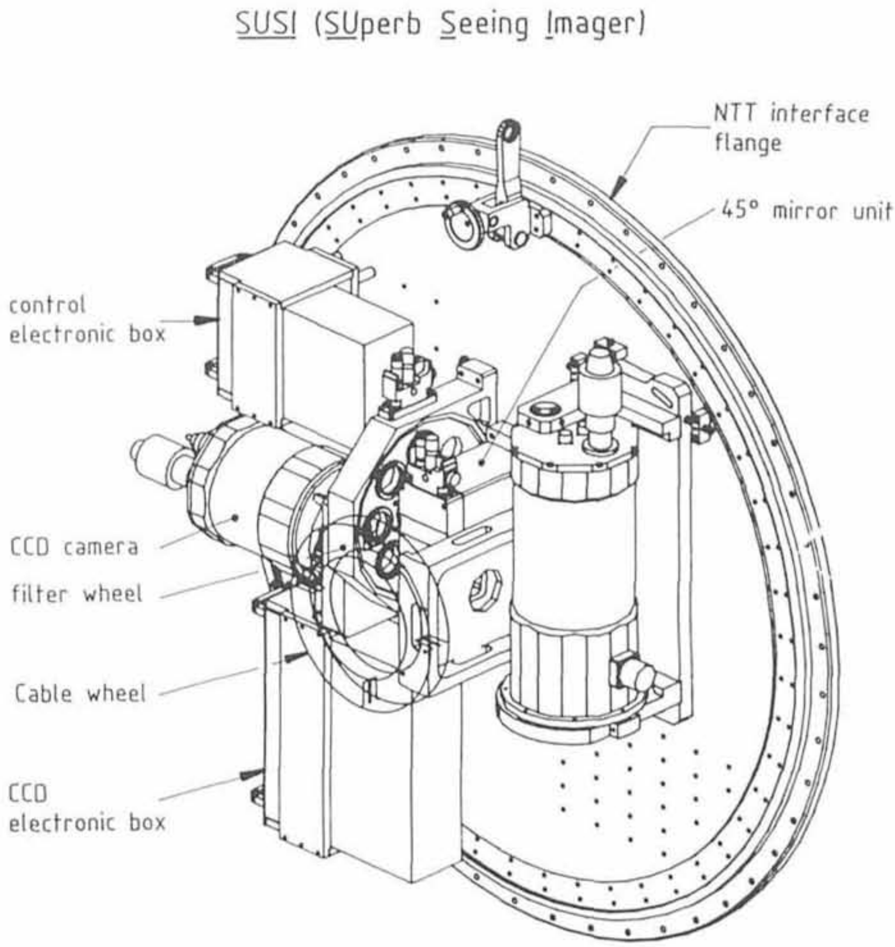

Figure 2: *Technical details of SUSI components. The second dewar could be an infrared array camera or will be used as counterweight.*

SUSI

SUSI (the Superb Seeing Imager) is an instrument physically distinct from EMMI but complementing its observing capabilities. It consists of a supporting plate mounted on the adaptor of the Nasmyth A focus of the NTT, in front of the infrared spectrometer IRSPEC. Figure 1 shows the CAD image of the telescope and instrument. Figure 2 gives more details of the flange and SUSI. The change from focus A (SUSI or IRSPEC) to focus B (EMMI) and vice versa takes a few minutes only. A remotely-controlled 45-degree mirror mounted on this plate can deviate the telescope beam to a CCD camera. The image scale on the detector is that of the F/11 focus (1 arcsec = 186 microns or 5.36 arcsec/mm) and thus a standard CCD of 15-30 μm pixel size can fully exploit the optical quality of the telescope for imaging in periods of excellent seeing. Particular attention will be paid to the optimization of the detectors, these being the dominant component of this simple instrument. The characteristics of the TK1024 CCD which is likely to be used for the first run are the following: the pixel size will correspond to 0.13 arcsec, the field to 2.2×2.2 arcmin. A detailed description of SUSI will be given by S. D'Odorico and H. Kotzlowski in a coming issue of the *Messenger*.

The integration of SUSI on the NTT will start at the end of March. After its installation on the telescope, although the instrument is very simple, a number of test nights will be necessary not only to adjust the instrument but also to train the operators to a new observing style. According to the present planning, SUSI should become available to visiting astronomers in the course of Period 47.

The Need for a New Policy of Time Distribution

The distribution of telescope time at ESO, as in most of the other major ground-based "mission" observatories, is done twice a year. Only the start of each six-month period may differ from one institution to another. A detailed review of both the procedure of time allocation and the many parameters that one has to take into account when preparing the observing schedule for various telescopes has been given by Breysacher (1988, in *Coordination of Observational Projects in Astronomy*, eds C. Jaschek and C. Sterken, Cambridge University Press). Therefore we will not repeat it in full again here and limit ourselves to remind that a particular constraint, much more severe that one would at first assume, is the absolute need to reduce to a minimum the chance of focal-plane instruments on the telescopes. This is a strong requirement for efficient scheduling because any exchange of instruments implies delicate but also time-consuming mechanical and optical adjustments. An instrument cannot, for instance, be mounted for one short observation only, because the associated loss of telescope time to the community is then of the same order as that gained for a single user.

In short, the important and unavoidable consequence of all the constraints imposed on the scheduler is that once the "puzzle" for an observing period has finally been solved, the resulting observing schedule is so stiff that almost no change in it can then be envisaged without substantial modifications of the whole. The fact that travel arrangements for visiting astronomers to La Silla have to be made about two months in advance is a further strong limitation to modification at short notice of the observing schedule.

Such a situation is clearly not compatible with the implementation of flexible scheduling which, ideally, should allow to refit the schedule every night, almost in real time, according to the meteorological conditions – excellent seeing or low atmospheric vapour content, for example – prevailing at the observatory. Technically, such a mode of operation evidently requires that on the telescopes having various focal-plane instruments, one is able to execute any change-over without loss of observing time.

Flexible Scheduling of the NTT in the Second Half of 1991

Ground-based telescopes of the new generation, like the NTT, have their auxiliary equipment especially designed for this mode of operation. This is why ESO will start implementing flexible scheduling – although not at the ideal level described above – on this telescope as from Period 48 (1 October 1991 – 1 April 1992). The available instruments being EMMI, IRSPEC and SUSI, in a first stage the following policy has been proposed to and discussed with the OPC by the Director General. Three categories of programmes are considered.

(A) Programmes presented for observations with EMMI which explicitely include a back-up programme to be conducted by the observer with SUSI, should the seeing conditions become superb during his/her EMMI run.

(B) Programmes requesting either EMMI or IRSPEC exclusively, not capable of using superb seeing for decisive scientific advantage and which should be considered as "programmes with risk interruption", because if optimum seeing conditions appear, the astronomer-in-charge on La Silla is able to decide to interrupt such a programme in order to carry out a programme of type (C) with SUSI (by service mode). To compensate for the risk, such programmes should be allocated a minimum of three nights in order to ensure that these can still be carried out with some success even when interrupted.

(C) Programmes requiring direct imaging with excellent seeing conditions and hence SUSI exclusively. As these kinds of observations are unpredictable, they will be conducted in service mode. Typically, hours rather than whole nights will be requested. However, if applications for SUSI observations cannot be conducted during the requested period they will not be carried over to the next observing Period.

A Gain of Experience for the VLT

The flexible scheduling experiment described above aims at the best possible use of La Silla's best nights at the NTT. It will also contribute to establish detailed rules required for an efficient implementation of flexible scheduling in the future.

SUSI's deep high-resolution images of the sky will provide important information, new ideas, ancillary and complementary observations to the Space Telescope, transforming our paradigms of direct imaging.

The use of EMMI, IRSPEC and SUSI in a flexible mode will certainly contribute to achieve familiarity for the future use of the VLT with regard to instrumental design, operations mode and observing schedule optimization.

PROFILE OF A KEY PROGRAMME:

The Distance of the Centaurus Group – a Test for Various Distance Indicators

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Introduction

Extragalactic distances are not only important for the determination of the intrinsic properties of galaxies and clusters of galaxies, but also for the calibration of the (present) value of the Hubble constant H_o, which is one of the fundamental parameters of cosmology. This calibration has posed great difficulties in the past, mainly because of poorly controlled selection effects and because of the faintness of reliable distance indicators at the required distances. The NTT opens here new possibilities.

Background

Presently many extragalactic distance indicators are used without an objective judgement on the intrinsic merits of the specific method. For the Virgo Cluster more than eight different individual distance determinations (globular clusters[1], novae[2], supernovae[3], D_n-σ relation[4], Tully-Fisher method[5], planetary nebulae[6], Hβ-σ relation of HII-regions[7], surface brightness fluctuations,[8] etc.) are available, but the results are at least partially uncertain and discrepant, such that the Virgo distance is still considered to be controversial (with values between 15 and 22 Mpc)[9]. An objective analysis of the different methods and their uncertainties is very difficult here because of the relatively large distance of the Virgo cluster and the heterogeneity of the data.

In the present programme, therefore, the reliability of as many distance indicators as possible will be tested in a nearer group of galaxies, where also Cepheids – the most reliable distance indicators at present – are still accessible, and where the dependence of the distance indicators on galaxy type and galaxy luminosity can be studied.

The Key Programme intends to determine the distance of five members (2 early-type, 3 late-type galaxies, covering a wide range in luminosity) of the Centaurus group using Cepheids, novae, globular clusters, planetary nebulae, brightest stars and others as far as possible. This group is 2 to 4 times nearer than the Virgo cluster and the observational limitations are therefore much less severe. On the other hand the group is distant enough that CCD frames cover a significant fraction on individual group members.