we may have improvements as high as a factor of 20 in the U band in SUSI. The SUSI control software is going through final testing and seems to work well, although some parts of the system, especially linked to the interaction of SUSI with the telescope, are still not fully tested. EMMI underwent a complete clean-up and has had a new grism wheel, the refurbished red camera, and the new RILD mirror re-installed. The new EMMI software, which is almost identical to that running in SUSI is also being tested.

The plan for the NTT upgrade which was approved by the STC and ESO management had the telescope returning to partial operations on the 1st of February. Some of you who submitted applications have already been through ESO and completed the Phase 2 Proposal Preparation process. After seven months of keeping to the daily NTT upgrade schedule religiously, I am sorry to say that the project has slipped. The first execution of a service programme took place 4 days later than planned for, on February 5th. The telescope is still in shared-risks mode and we have quite some way to go before the requirements set on the telescope and instrumentation are met. However, we believe we are close enough to be exercising the telescope and trying to do real science. I should emphasise that we are not guaranteeing any performance figures before the 27th of June when the NTT returns to full operations. However, we shall do out best to deliver science quality data to as many users as possible.

On the operations front, an enormous amount of progress has been made. The output of P2PP is now being passed to the control system in a transparent fashion and provides the parameters for the automatic execution of the programmes. The observing and target acquisition templates are running and some calibration templates are also available (e.g. automatic focusing and sky flat fields). In this way we can ensure to be doing exactly what the users specified. In December/January, we took delivery of the archive and pipeline data reduction workstations. They have been integrated into the NTT control system and while they are still running prototype software, the data do flow across the complete system and do get automatically reduced. The reductions right now are pretty rudimentary but there is no reason why this work cannot be expanded to provide the users with a first cut at their data.

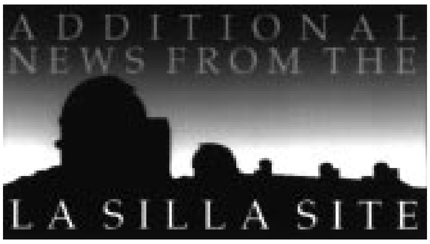
As mentioned earlier, the NTT upgrade still has 5 months to run. For the time being we have been finding and solving the 1 in 1 bugs. Over the next months we have a lot of work to do. Not only do we have to acquire the necessary experience with service observing, but also find the 1 in 10 and hopefully the 1 in 100 bugs. We also have some maintenance we wish to do, which we did not wish to perform while the first phase of the upgrade was taking place. This was a decision based on various planning and technical reasons. We plan that the NTT shall continue over the next months to improve in reliability and expand the functionality of the telescope. In April we plan to start with some limited service observing using EMMI.

I would like to take the opportunity to thank all our colleagues in all the ESO divisions that have helped to make the new NTT a reality.

Staff Movements

I would like to welcome to the NTT team our new instrument operator Norma Hurtado.

Jason Spyromilio
jspyromi@eso.org



The La Silla News Page

The editors of the La Silla News Page would like to welcome readers of the sixth 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)*

The Image Quality of the 3.6-m Telescope (Part V)

What Happens far from Zenith?

S. GUISARD, ESO-La Silla

Earlier articles about the Image Quality (IQ) at the 3.6-m telescope (part I to part IV, see previous Messenger issues) concerned the IQ near zenith. Final conclusions and improvements have been written already [1]. In this article we will present the results of the study since September, 1996, when we started to analyse the telescope behaviour far from zenith.

1. Introduction

The IQ of a telescope degrades as the telescope moves from zenith. For a mechanically perfect telescope, this degradation is due only to the natural seeing which worsens with increasing airmass. However, for real telescopes, mechanical flexures accelerate the degradation. These flexures affect the structure of the telescope itself and the mirror supports.

Flexures of the Serrurier struss misalign the two mirrors of the telescope and cause mainly decentring coma aberration. Malfunctionning of the mirror cell with zenith distance is more likely to create astigmatism and triangular coma. We shall see that the 3.6-m is no exception to this rule.

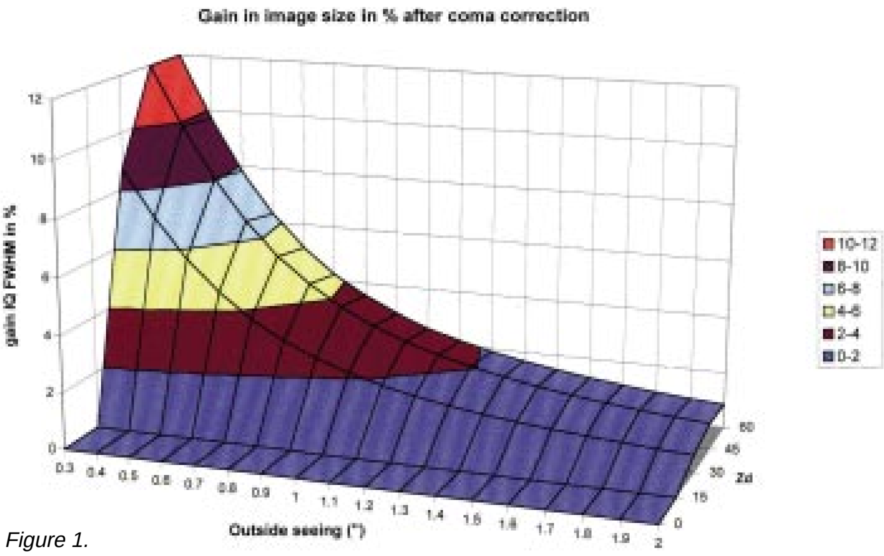


Figure 1.

2. Measuring the Optical Quality at Large Zenith Distances

This work started in September 1996 and is continuing. It is only because of a rigorous test scheme, involving many test nights, that the telescope aberrations are now understood. The aberrations are calculated from extra-focal and intra-focal images using the curvature sensing method.

Since September 1996, more than 1300 defocused images have been taken and analysed, with the distance from zenith ranging from 0 to 60 degrees and with the telescope pointing in different positions. Movement cycles were done also to study the hysteresis of the aberrations. Two detailed technical reports have been written [2], [3]. Here we will only summarise the main results.

Table 1 summarises the variation of each of the aberrations with zenith distance. The aberrations that change most are coma, astigmatism and triangular. The spherical aberrations (at the new focal plane [1]) and quadratic astigmatism are included in the row ‘other terms’ and do not change much with zenith distance. The values in this table are averaged over many azimuth positions. In practice, the telescope behaviour changes if it points South, East, West or North. The aberrations are given in arcsec d80% (diameter of the circle containing 80% of the light).

The aberration that was expected to change most was coma; however, the changes are much smaller than what had been reported several years ago. Indeed, the flexure of the telescope is much smaller than stated in the old reports. Gerardo Ihle (Mechanics Support Team, La Silla) confirmed this by a finite-element analysis of the telescope structure.

The surprise came from the astigmatism and triangular aberrations which have large changes with zenith distance. These aberrations are due to the primary mirror and its support.

The triangular aberration is in fact a fixed defect of the mirror after it was polished. But in order to compensate for this aberration, the polisher, twenty years ago, deliberately modulated the axial force on the astatic levers below the mirrors. The aberration is therefore compensated at zenith but reappears as a cosine function of zenith distance when the telescope is inclined. This is exactly what we measure.

Part of the astigmatism has the same cause; the other part is due to the pneumatic lateral supports of the mirror which do not work properly.

3. Solutions

3.1 “Semi-activation” of M2

Decentring coma can be corrected by moving the secondary mirror. In the case of the 3.6-m, we call it ‘semi-activation of M2’, as, unlike the NTT, the movements of the secondary mirror will de-point the telescope. Therefore, coma correction can only take place between exposures.

Successful tests of semi-activation have been done during test nights. Coma could be completely corrected for zenith distances of 45 and 60 degrees; however, this correction did not reduce significantly the image size because other terms, like astigmatism and triangular aberration, are as important as coma (see Table 1). Furthermore, the outside seeing depends on zenith distance and this makes the correction of coma less impressive than expected. For example, the IQ at 60 degrees zenith distance with a natural seeing of 0.60″ at zenith will be 1.22″ without coma correction and 1.15″ with the correction. Without degradation of the image by astigmatism and triangular aberration, this would be 1.05″.

Figure 1 gives the gain in IQ in % as a function of zenith distance and outside seeing (given at zenith) when only coma is corrected. On this graph, the other aberrations have the values given by Table 1. If we set the criteria for correcting the decentring coma as an improvement of 10% in the image size (which corresponds to a gain of 1.2 in exposure time), we see that it is worth semi-activating M2 only for outside seeing better than 0.4″ and zenith distances larger than 45 degrees. This situation may happen for a few hours in a year only!

Figure 2 also gives the gain induced by coma correction but assuming that astigmatism and triangular keep their values of 0.15″ for any position of the telescope. In that case semi-activating M2 becomes more attractive.

3.2 Eliminating the dependence of astigmatism and triangular aberrations on zenith distance

As we saw above, this correction is a necessity as it will improve images and make the correction of coma useful. It requires significant work on the primary mirror cell, mainly the axial supports. Solutions have been found already. The idea is to change the force distribution on the astatic levers below the mirror as if the mirror were perfect. This would of course introduce at zenith the constant triangular pattern of the mirror. This aberration has to be compensated by axial forces independent of zenith distance like springs for example.

Part of the astigmatism should also be corrected in this way, the other part of the astigmatism will be removed by improvements of the lateral pneumatic mirror support system.

Technical time has been requested for April 1997 to install load cells on all the mirror supports (33 axial and 21 lateral supports). This change involves the manufacturing of nearly 200 mechanical pieces, which has started already in the La Silla workshop, and 2 weeks of telescope time to install the axial load cells in April. The installation

TABLE 1

Zenithal distance (deg)	0	15	30	45	60
Coma (d80%)	0.20″	0.20″	0.35″	0.40″	0.45″
Astigmatism (d80%)	0.15″	0.15″	0.20″	0.30″	0.45″
Triangular (d80%)	0.15″	0.15″	0.15″	0.20″	0.30″
Other terms (d80%)	0.25″	0.25″	0.25″	0.25″	0.25″
Total (d80%)	0.40″	0.40″	0.50″	0.60″	0.75″

of the lateral load cells will follow, and we should be able to have full information on the support forces by the end of August this year. Time will be requested before the end of the year to change the force distribution below and around the mirror, and to install springs on the axial astatic levers.

A detailed planning of the intervention on the primary mirror support has been prepared by Roland Gredel. We hope that all the necessary work on the mirror cell can be done within the year.

4. Conclusions

The behaviour of the telescope at large zenith distance in terms of optical quality has been investigated carefully since September last year. Improvement plans have been proposed and work has started already. The phase we are entering now is very delicate as it involves the intervention on the mirror support itself. Everything will be done not to degrade the optical quality at zenith while changes are made. More technical time will be needed before the end of the year to decrease the aberrations for all telescope positions. The 3.6-m is getting better; however, much work still has to be done.

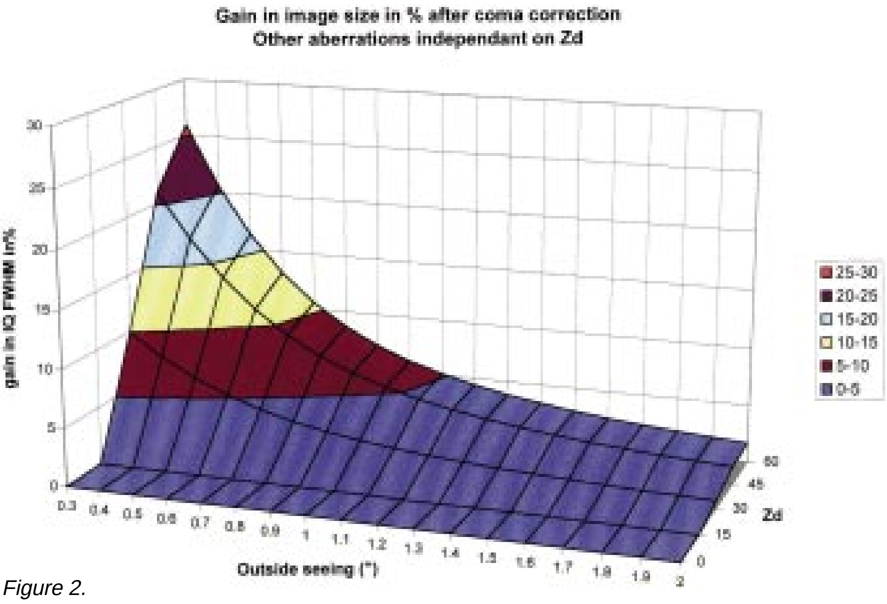


Figure 2.

References

[1] S. Guisard: The Image Quality of the ESO 3.6-m Telescope (Part IV): Better than 0.6″, *The Messenger* No. 86, December 1996.

[2] S. Guisard: 3.6-m + CAT Upgrade, "Report on the test nights 7th and 8th October 1996", 3P6-TRE-ESO-032-009, October 1996.

[3] S. Guisard: 3.6-m + CAT Upgrade, "Report on the test nights 18/10/96 and 19, 20, 25, 26, 27/11/96", 3P6-TRE-ESO-032-010, December 1996.

Stephane Guisard
e-mail: sguisard@eso.org

From the 3.6-m and 2.2-m Teams

During October 1997, EFOSC2, the imaging spectrograph now at the 2.2-m telescope, will be moved from the 2.2-m to the 3.6-m. The current spectrograph on the 3.6-m, EFOSC1, will be de-commissioned. EFOSC2 on the 3.6-m will have higher throughput, a larger field of view and significantly better image quality than what was possible with EFOSC1. The significantly smaller pixel scale of the EFOSC2 CCD, 0.18 arcsec per pixel at the 3.6-m telescope, compared to 0.61 arcsecond per pixel of EFOSC1, will allow observers to fully exploit the recent progress in the improvement of the 3.6-m image quality (see S. Guisard's reports in *The Messenger*, December 1996, March 1997). Multi-object spectroscopy will not be avaible with EFOSC2 during Period 60 but only in Period 61 and thereafter.

For ESO time during period 60, the 2.2-m will be dedicated to observations with the two infrared cameras, IRAC1 and IRAC2b.

2.2-m Telescope Upgrade Plan

With the 3.6-m upgrade in progress, the 2.2-m telescope will be the only major telescope on La Silla which still runs off an HP-1000 computer. To make sure that the 2.2-m telescope will be maintainable into the next decade, we are preparing an upgrade plan for the telescope which will be presented to the STC in the beginning of May. The upgrade plan will discuss both the possible replacement of much of the electronics and computers as well as possible modifications to the drive system and possible improvements of the image quality. This will be a good opportunity to address some long-standing problems with this otherwise excellent telescope. *J. Storm*

News from the Danish 1.54-m Telescope

J. BREWER and J. STORM

TCS User Interface Upgrade

A new TCS graphical user interface (GUI), written by Gaetano Andreoni using the VLT panel editor, is now in use at the Danish 1.54-m telescope. Observers will find that the frequently used telescope and adapter controls are now contained within a single window, while lesser-used functions are within a dismissable pop-up window. A 'virtual handset' can also be enabled from the main control window. The new interface retains the same functionality as the old interface, though it is simpler and more user friendly. The new interface also offers the advantages that it is significantly more robust than the old system and is easily modifiable.

DAISY

A new instrument GUI, based on the GUI at the Dutch telescope, is now in use at the Danish 1.54-m telescope. DAISY (Data Acquisition Integrated SYstem), written by Eduardo Robledo, combines the control of the CCD Camera, the DFOSC (Danish Faint Object Spectroscopic Camera), the FASU (Filter And Shutter Unit), and the telescope focus control all into one package. Observers will find that DAISY is very easy to use; the operation is intuitive and there is little to remember. The DAISY