E TELESCOPE OPERATIONS & COMPUTING DIVISION

Head of Division: *L A Balona*

The Telescope Operations Division has the task of ensuring that the existing observational facilities, including telescopes, domes and commissioned instruments, are maintained in a suitable condition to allow SAAO to perform its function as a National Facility.

Furthermore, it is charged with drawing up an observing schedule for each quarter based on applications received, both from South African astronomers and from scientists in other countries. SAAO staff are asked to comment on the scientific justification and on the practicality of completing the project with the available instrumentation. The observing schedule was drawn up by C Koen in consultation with L Balona, and submitted to the Director for final approval or modification before publication.

E1 TIME ALLOCATION

As the National Facility for optical/infrared astronomy in South Africa, SAAO makes telescope time available to qualified astronomers in South Africa. A certain percentage of time is granted to astronomers from other countries, to encourage both scientific collaboration and technological exchange with South Africa and to promote the exchange of ideas and information. The availability of observing time at Sutherland is advertised on the SAAO website (*www.saao.ac.za*). Applications from both inside and outside the country are considered quarterly. Time allocations are made on the basis of scientific excellence and technical feasibility.

A breakdown of time allocated as a function of user category is shown in Table E1. The association of a particular observing allocation with a given user group is made on the basis of the principal applicant's affiliation as given in the original observing application. The statistics were compiled from the official records as published on the SAAO website. Although SAAO is listed as using 77% of the time on the 0.5-m telescope, a significant fraction of this was observing time done on behalf of non-SAAO astronomers (both local and inter–national) in the "general" program.

E2 OPERATIONAL STATISTICS

Observers are required to keep a log of hours worked and of time lost through instrument or telescope faults, or adverse weather conditions. Statistics based on these reports give an indication of the quality of the Sutherland observing site. Some time is used for telescope or instrument tests and upgrades and for aluminizing. This is a necessary part of keeping the operation of the observatory at peak efficiency, but the time allocated is kept to a minimum. Table E2 shows the percentage of available observing time which was actually used, and time lost to poor weather, to engineering or aluminizing and to faults. Some weeks remained unallocated on the smaller telescopes (particularly on the 0.75-m). This can, to a large extent, be attributed to the demands of SALT on SAAO staff. In general, weather con–ditions in 2001 were less favourable than in 2000, leading to a drop of 12.4% of observing in 2001 compared to 2000.

E3 TELESCOPES

Each telescope has a manager who is responsible for all aspects of maintenance and operation of the telescope and associated structures. No major problems were encountered on any telescope during 2001.

Table E1. Percentage Telescope Time as a Function of User Group

Telescope	SAAO %	UCT %	Other S.A. %	International %	Unallocated %	Aluminize %
1.9-m	47.5	20.0	1.5	31.0	-	-
1.0-m	33.8	13.8	6.1	41.8	3.0	1.5
0.75-m	67.7	4.6	-	20.1	6.1	1.5
0.5-m	77.0	3.1	1.5	12.3	6.1	-
All	56.5	10.3	2.3	26.3	3.8	0.8

Table E2. Telescope Usage, as a Percent of Total Possible Time

Telescope	Observing %	Lost to Weather %	Engineering %	Faults %	Not Allocated %
1.9-m	58.6	40.3	0.7	0.4	-
1.0-m	47.5	43.5	1.2	0.4	7.4
0.75-m	47.2	43.2	0.6	0.2	8.8
0.5-m	39.1	53.6	0.3	0.2	6.8
All	48.1	45.2	0.7	0.3	5.7

E3(a) 1.9-m Telescope

Telescope Manager: L Balona

A new observing ladder was manufactured as the old wooden one did not meet safety requirements. During the year problems were experienced with the field acquisition/autoguider system. The situation was rectified by cleaning and adjusting the XY-slides. Although this resulted in a significant drop in faults, it is recognized that the symptoms will recur unless the system is replaced. The design and manufacture of new XY-slides are under way.

The telescope control system is now almost 20 years old, with the result that many components can no longer be obtained. A re-design of the telescope control electronics was initiated with a view to replacing the existing system by the end of 2002 or early 2003.

E3(b) 1.0-m Telescope

Telescope Manager: J Menzies

The 1.0-m telescope continued to operate satis–factorily. There was one episode of the still unexplained degradation of image quality reported in earlier years. No progress was made on solving this problem.

The remarks above on the XY-slides and telescope control system of the 1.9-m telescope also apply to the 1.0-m telescope, and it is hoped that new XY-slides, field acquisition/guiding and telescope control systems will be ready by the end of 2002.

E3(c) 0.75-m Telescope

Telescope Manager: P Martinez

This telescope performed without any major problems during 2001. Some problems were reported concerning sluggish dome movement in cold weather and occasional problems related to dome tracking were reported. Problems with telescope nodding during infrared observations were encountered with the telescope reversed. The problems arose because the telescope control software does not cater for this mode of operation. After considering several solutions, it was decided to implement “reversed” nodding through a hardware switch, which was installed on the telescope. To minimise the disruptive effects of grazing reflections of moonlight off the dome slit and into the telescope (particularly near full-moon periods), the top end of the telescope was enclosed in a shroud. This has largely eliminated the problem.

E3(d) 0.5-m Telescope

Telescope Manager: C Koen

This telescope continued to perform well through–out the year.

E3(e) 0.75-m Automatic Photoelectric Telescope (APT)

Telescope Manager: D Kilkenny

Development work on the Automatic Photoelectric Telescope (APT) during the period under review focussed on making the system robust in the Sutherland environment, and on providing improved capability to modify the system remotely from Cape Town. In January, hardware and soft–ware enhancements to start up and shut down the APT remotely from any machine on the SAAO network (Sutherland or Cape Town) were completed. This allows the support astronomers to monitor APT operations remotely and to shut down the system if necessary. Various software enhance–ments were made to the control system, based on the first year of operational experience. In March 2001, it was decided to remove the mirror covers permanently, and to park the telescope at high zenith distance when not in use. A mirror blowing regimen was introduced to keep the mirror dust-free between washes. The quality of the APT mirror surface with this cleaning regimen is excellent. In August 2001, automatic data logging to a machine

Table E3. Percentage of Time Allocated to Specific Instruments on Different Telescopes

Instrument	1.9-m %	1.0-m %	0.75-m %	0.5-m %
CCD Spectrograph	36.0	-	-	-
IR Photometer MkII	-	-	47.5	-
IR Photometer MkIII	15.4	-	-	-
GIRAFFE	22.0	-	-	-
UCT CCD	13.4	13.8	31.0	-
UCT Photopolarimeter	11.7	3.0	9.1	-
DANDICAM	-	40.0	-	-
SAAO CCD	-	12.3	-	-
StAP	-	18.5	-	-
PICNIC	-	-	3.0	-
STE4	-	6.2	-	-
Modular Photometer	-	-	-	94.9
Own[1]	-	-	3.0	-
Alum/Engineering	1.5	3.1	1.5	-
Unallocated	-	3.1	4.9	5.1

Note: [1]Manchester Wide Field Camera

accessible from Cape Town was introduced. In October, the MS DOS-based APT control software was relocated to a Linux computer, allowing remote development of the control system and alterations to observing programmes from Cape Town. This has eliminated the need for unscheduled trips to Sutherland to solve minor problems with the APT. Since November 2001, during the week, each night's data have been reduced the following morning. This was made more robust in January 2002, following some data losses due to un–intentional interference by other computer network users in Sutherland. Subsequently, no data have been lost due to this problem. All of these modifi–cations and enhancements have made the APT more robust, and more independent of human support for normal operations.

During the period under review, the APT was used for a number of programmes, supporting research by the three institutes involved in the construction of the system. These included studies of the stellar rotational periods of rapidly-oscillating peculiar A stars (roAp stars) in two separate programmes proposed by P Martinez and G Handler (SAAO); a short-term study of close binary systems (WUma stars) with very short periods (< 1 d) for which complete, or almost complete, light curves could be obtained in one night for B Cunow (Unisa); long-term studies of hydrogen-deficient stars, including R Coronae Borealis stars, hydrogen-deficient carbon stars and extreme helium stars by D Kilkenny (SAAO) and L Crause (UCT); and long-term studies of dusty post-AGB stars (RV Tauri stars and the like) for T Lloyd Evans (SAAO). A programme to look for rapid variables (Beta Cephei stars) in the galactic open cluster NGC2516 failed because the system could not effectively measure stars in the very crowded fields. *UBVRI* data were obtained for almost all of these projects; *UBV* data for the rest. Because the APT is not yet fully automated (we do not have, for example, a dedicated weather monitor), we still rely on an "on-site" observer to start off the system and close it down if conditions deteriorate. It does occur from time to time that none of the observers in a given week is a qualified 'APT operator' and perhaps 11 weeks out of the 65 in the period under review were lost because of this (about 17% of the total). For the remainder, the APT has gathered data on about 160 nights – or about 42%.

E4 INSTRUMENTS

Once an instrument is commissioned, the project scientist (who would usually be an astronomer who made the original motivation for it) assumes full responsibility for its maintenance – both hardware and software.

The percentage of time allocated to each instrument is shown in Table E3. The pattern of use is essentially unchanged from previous years, although the fraction of time being used for spectroscopy on the 1.9-m telescope is down by 10%.

E4(a) Cassegrain Grating Spectrograph

Project Scientist: D Kilkenny

No changes were made to the spectrograph. A minor, but recurring, problem due to light leakage from LED sensors was reported and cured. Problems with CHRISTO software constitute a large fraction of the fault reports. This software will soon be replaced by an entirely different system.

E4(b) GIRAFFE

Project Scientist: D Buckley

At the end of 2001, a new RT Linux-based CCD control program (QUARTZ) replaced the DOS-based GODOT program. Apart from this GIRAFFE continues to perform well.

E5 EXTRAMURAL ACTIVITIES : BOYDEN OBSERVATORY

The 1930s vintage 1.5-m telescope of Boyden Observatory is owned and operated by the University of the Free State (UFS). With the passage of time and the lack of local astronomical expertise, the telescope became outdated and ceased to be a productive research telescope. Over the past 6 years, the University has gradually reintroduced astronomy into its curriculum, and this motivated a need for local telescope facilities. In keeping with its policy to support the development of astronomy at South African universities, the SAAO supported the refurbishment of the Boyden 1.5-m telescope. Over the past several years, P Martinez has co–ordinated these activities.

A strategic decision was taken early on in the project to involve foreign partners. It was felt that foreign partners would find dedicated access to a Southern Hemisphere telescope attractive, and would, therefore, be prepared to contribute towards the refurbishment exercise. Moreover, a foreign partner would inject a fresh scientific stimulus into the South African astronomical community. It was decided that a dedicated programme would prove most effective with regard to attracting foreign partners, and in generating optimum science for a limited amount of operational support in terms of funding and available staff. To stimulate the interest of potential partners, the NRF agreed to contribute R300 000 to the project, provided the balance could be sourced by local or foreign partners.

These efforts came to fruition during 2000, when a Memorandum of Understanding was signed between UFS, Notre Dame University, USA and Lawrence Livermore National Laboratory, USA. Together with the NRF contribution, the refurbishment was fully funded. The total costs relating to the refurbishment amounted to $98 000. This was funded by the NRF (R300 000), the University of Notre Dame ($46 000), and the University of Pennsylvania ($19 000).

The telescope was given an extensive refurbishment between August and September 2001 by the DFM company based in Longmont, USA. The telescope was equipped with a new telescope control system, new DC motors on the declination and right ascension drives, as well as automated dome control. A number of handsets were also installed throughout the dome.

The upgrade was a big success. The all-sky rms pointing accuracy after the refurbishment is appro–ximately 20 arc seconds. The telescope tracking and dome control is also satisfactory. The refurbished telescope was commissioned on 11 September 2001.

During February 2002, Dr K Cook (LLNL) visited Boyden. During his stay, a 1k × 1k Pixelvision CCD camera system and control computer (worth $55 000) were installed on the Cassegrain focus of the telescope. The camera system is thermo-electrically cooled and is mounted in an acquisition box with a XY-slide, accommodating a ST-6 CCD camera for autoguiding. The CCD system is also equipped with a standard *UBVRI* filter wheel, which allows *UBVRI* photometry to be carried out. The system was fully operational by the end of February 2002. After the installation was completed, image acquisition software was developed to automate and speed-up the observations. The system, SPICA, was developed by UFS astrophysics MSc student, J J Calitz, as part of his MSc studies under the supervision of P J Meintjes (UFS).

From March 2002, the UFS-Boyden 1.5-m tele–scope started contributing towards several inter–national campaigns; e.g. the MPS planet search project (Principal Investigator is D Bennett, Notre Dame), the REACT GRB follow-up search (Prin–cipal Investigators are K Cook, LLNL and P Meintjes, UFS), as well as the study of galactic accretion driven systems (Principal Investigator is P Meintjes, UFS). There are also plans to participate in the monitoring of near-earth objects that may pose a threat to earth.

To date, the R300 000 contribution by the NRF has leveraged R1.1 million worth of contributions by foreign partners in the Boyden project.

E6 COMPUTING DIVISION

The SAAO computer system consists of two local area networks, one in Cape Town and the other in Sutherland, connected by a 128 kbs link. Both LANs lie behind a firewall and are connected to the Internet via a 256 kbs link, of which 128 kbs can be used outside South Africa, while 128 kbs is reserved for communications within the country. TENET continues to be the service provider.

At the core of the network are the five servers, *rigel*, *sirius*, *canopus*, *maia* in Cape Town, and *orion* in Sutherland. These run Red Hat Linux. Most scientists have desktop Linux systems connected to the network, while administrators and engineers use MS Windows systems. During 2001, *sirius* and *canopus* were replaced by newer machines with increased disk capacity. Software for data reduction, such IRAF, STARLINK and IDL is available on all servers. DDS-2 DAT drives and CD-ROM writers are available for off-line data storage. DDS-2 DAT tape is the mass storage medium at Sutherland.

The computer systems at the telescopes are based on Linux or DOS. There is an ongoing program to port all DOS software to Real Time Linux. During 2001, the GIRAFFE echelle spectrograph CCD data acquisition system was re-written in RT Linux. Plans are in hand to port the field acquisition and autoguiding system to RT Linux by the end of 2002. In addition to porting of software, SAAO has a legacy of using ISA interface boards for input/ output to various instruments. The ISA bus is no longer supported by normal commercial PC manu–facturers. Fortunately, SAAO is not alone in this regard and there are several manufacturers which produce motherboards with any number of ISA slots. One of these industrial PCs was purchased in early 2002 with the intention of using it to replace the long obsolete 486 PCs used in the APT.

E7 BANDWIDTH STATISTICS

The low bandwidth between Cape Town and Sutherland continues to be a bottleneck. Unfor–tunately, lack of funds has prevented a speed upgrade thus far. Most of the bandwidth is currently used by non-SAAO users. Demand is likely to escalate when MONET and SALT become opera–tional. Hopefully, funds will be made available for an upgrade before that time.

In Table E4, we show the percentage of bandwidth used by different institutes. Most of this bandwidth passes through the Cape Town – Sutherland link as well.

Table E4. Bandwidth usage, as a percent of total bandwidth, for various institutes from July 2001 to June 2002.

Acronym	Institute	Internet Bandwidth %
SAAO	South African Astronomical Observatory	31.1
SALT	South African Large Telescope	15.7
ERASMUS	Dr Andre Erasmus	8.2
SUR	University Southern California Seismograph	12.4
GFZ	South African Geodynamic Observatory	12.1
HARTRAO	Hartebeeshoek Radio Observatory	5.6
BISON	Birmingham Solar Oscillation Network	0.3
IRSF	Infrared Survey Facility	13.9
YSTAR	Yonsei University Telescope	0.7