SOUTHERN AFRICAN LARGE TELESCOPE

2004 saw the completion of most of the remaining subsystems of SALT, in particular installation of the long-awaited spherical aberration corrector (SAC) and the continued delivery of primary mirror segments from the ITT (formerly Eastman-Kodak), with a total of 79 having been delivered by the end of the year.

ON-SKY TESTING

September 2004 saw the commencement of the second phase of on-sky testing, which was held up until the installation of the Spherical Aberration Corrector (SAC) and the replacement of a faulty motion control card on the Tracker. These initial tests involved using 37 segments – three complete rings and the central segment – to undertake the so-called "sub-array" acceptance tests of the Tracker. These tested the functionality of the Tracker and in particular the Prime Focus Payload (PFP) alignment system, which uses a laser auto-collimator and a Mach-Zender interferometer, respectively, to keep the PFP properly aligned in tip/tilt and at the correct distance relative to the primary mirror array. This is crucial to ensure that the SAC optical axis is always on a radius of curvature vector while tracking, otherwise the image quality would deteriorate significantly.

By the time of the next phase of testing the following month, a total of 51 segments were installed (see Figure 10), already making SALT equivalent to a 7.5 m diameter telescope.

One of the first images obtained was of the globular cluster 47 Tuc, a good southern target with a potentially long track time (~hours). The image shown in Figure 11 was taken on 14 Oct, when we had 51 segments installed and aligned. Although prototype edge sensors were installed and tested in 2003 on the first 7 segments, the on-sky observation in 2004 did not use the

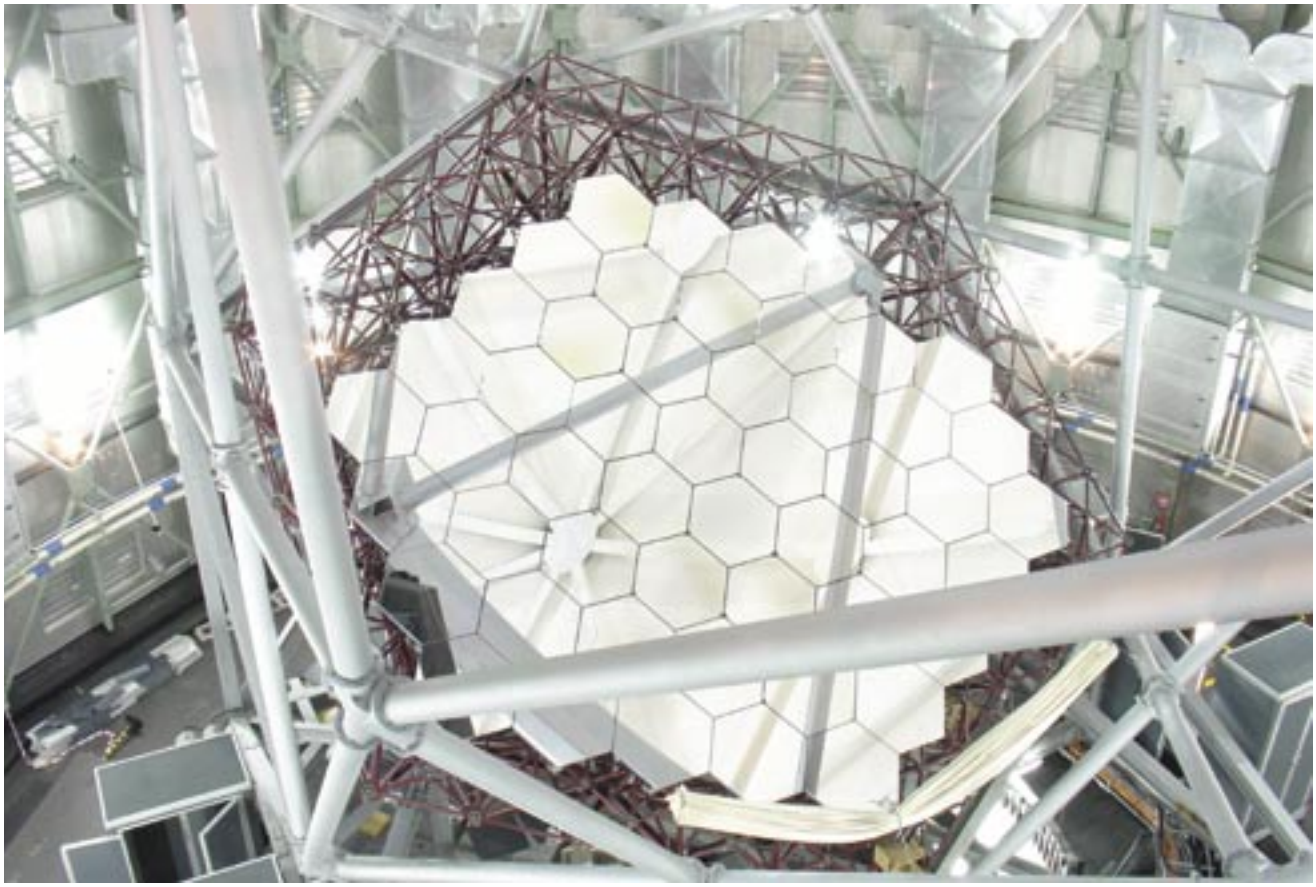

Figure 10. 51 installed mirror segments in SALT (October 2004)

edge sensors, since they were still undergoing development. For these tests the mirror array was aligned optically using the Centre of Curvature Alignment System (CCAS), a Shack-Hartmann wave-front camera mounted atop the 30-m high CCAS tower. This was done as frequently as necessary, and provided the conditions remained fairly static during the night (particularly the temperature), then the mirrors stayed in good alignment and produced respectable images, as evidenced in Figure 10, which was an image taken ~2 hours after a mirror alignment. The image quality was surprisingly good considering there is no active alignment yet, with symmetric star images of ~1.1 arcsec FWHM, somewhat better than the overall specification for the telescope in median seeing conditions.

SCIENCE OBSERVATIONS

Even though the telescope was not yet complete, this did not stop attempts at the first scientific observations with SALT during 2004! This further demonstrated that the telescope could deliver quite respectable images, and despite there only being just over half of the mirrors in place at the time, SALT had already enough light gathering power to be scientifically useful. Its ability is demonstrated in Figure. 11, an image of the first galaxy observed by SALT, the Seyfert II object NGC1068 (M77).

These tests also demonstrated that SALT could point and track with sufficient accuracy that objects could be observed over an extended period (~hours). Further tests were carried out on the night of 27 October 2004 when SALT was used to obtain time-series photometry on 4 objects using SALTICAM. Since no filters were then installed, these observations were done in "white light". The SALT Project Scientist (D. Buckley) and SALTICAM Principal Investigator (D. O'Donoghue) devised an observing program to exercise one of the unique characteristics of SALT and its first-light instrument (SALTICAM), namely high-speed photometry. Four highly variable objects - magnetic cataclysmic binary stars - were chosen, two of which were predicted to undergo eclipses (lasting ~tens of minutes) during the SALT observing window for that night. These objects were observed with SALTICAM in so-called frame transfer mode with a pre-binning factor of 5 x 5 pixels, allowing the dead-time between CCD readouts to be reduced to just a few seconds.

Repeat exposures of between 2 and 4 secs were done, allowing good time resolution, particularly of the eclipse ingress/egress events, where the accreting white dwarf star (~Earth sized) is eclipsed by it companion red dwarf (~Sun sized) in a matter of just tens of seconds. These

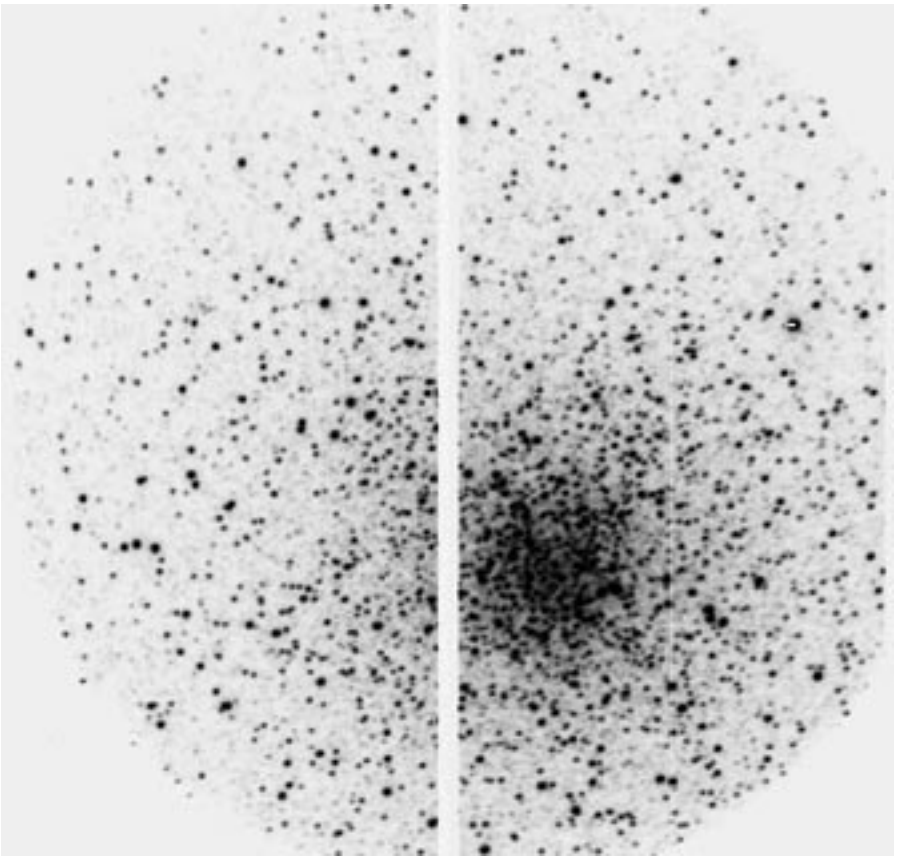

Figure 11. A 1-sec exposure of 47 Tuc on 14 Oct 2004.

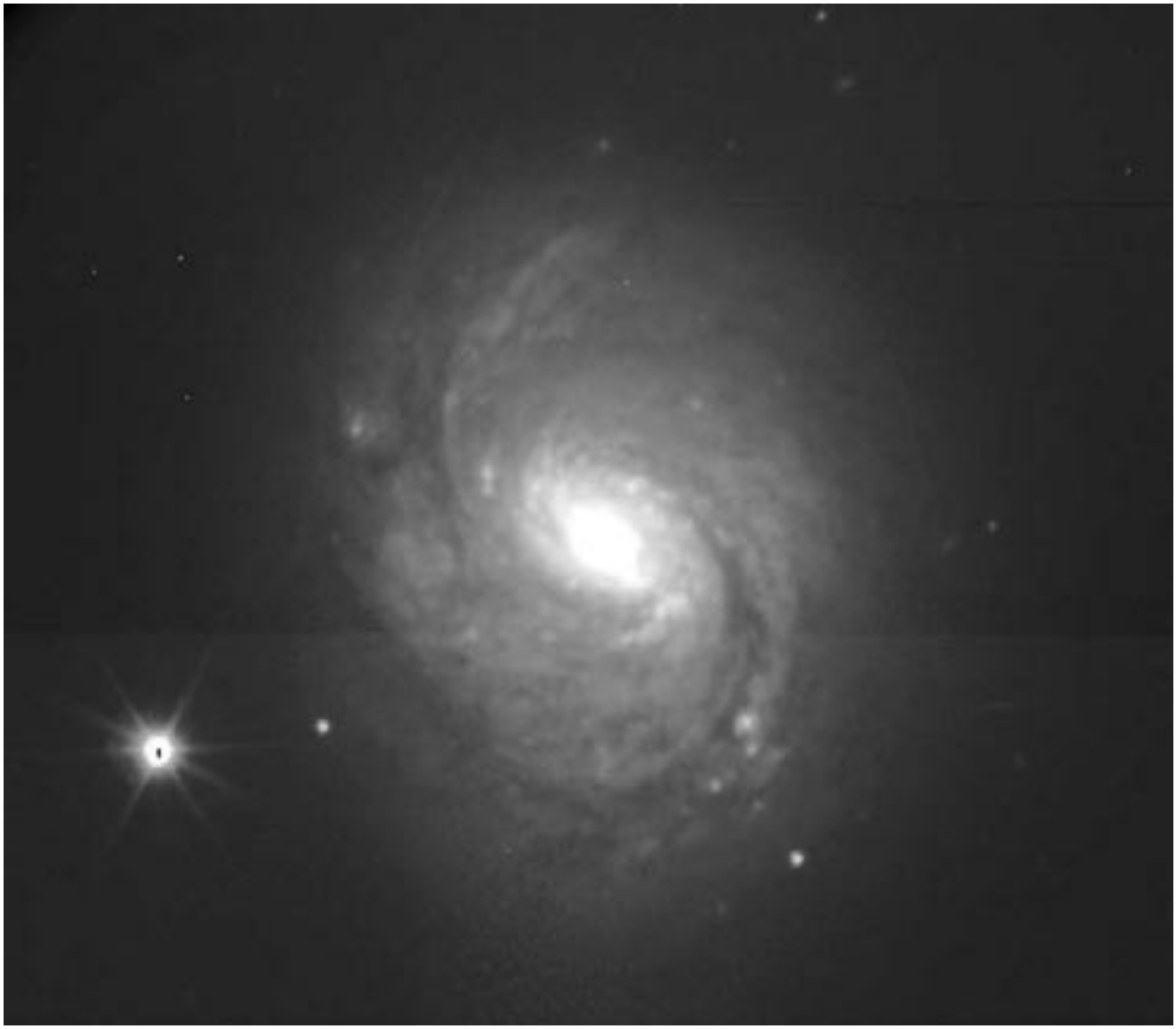

Figure 12. A 4 second unfiltered exposure of the active galaxy NGC1068 (14 Oct 2004)

observations demonstrated the capabilities of time resolved science with SALT, due to the combination of large collecting area combined with fast readout CCD detectors.

TELESCOPE COMMISSIONING

The end of 2004 saw substantial completion of acceptance testing of the Tracker and the start of system level acceptance testing of telescope pointing, tracking and image quality. The Tracker initially experienced significant technical problems, eventually traced to a faulty motion control card. Following its replacement, the Tracker has performed much more reliably.

By the end of the year, 79 mirror segments were delivered and installed in the telescope, filling four complete rings and 18 out of the 30 segments in the last, fifth, ring. The remaining 14 mirrors (which includes 2 spares) were subsequently delivered by the end of February 2005.

The SALT guidance and focussing system was tested out during 2004. This system is based on image fibre bundles mounted on probes that can access guide stars anywhere inside a 10 arcmin diameter circle. The Telescope Control System (TCS), which is being systematically installed in a number of software "builds", was at a sufficient level of

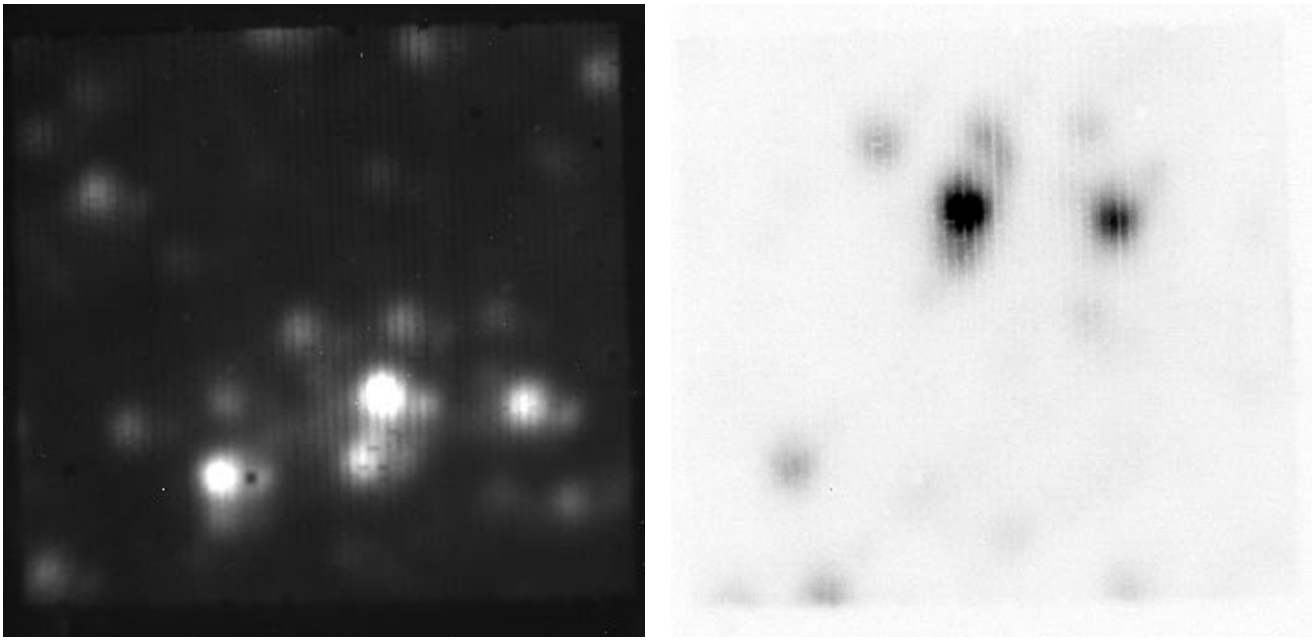

Figure 13. Images of the guidance 17 x 17 arcsec guidance probe field of view.

maturity by the end of 2004 to allow full testing and operation of the telescope and its subsystems. This included the partially installed Science Database (SDB) and the telescope Observation Planning Tool (OPT), used to schedule observations. Due to the complexity and staged development of the TCS, which includes the observation planning, simulation, proposal writing and submission tools to be used over the Internet by SALT users, this work will continue through most of 2005. The TCS team will therefore be kept on until Dec 2005 to see this work to completion.

Many of the SALT operations staff, particularly the technical support staff, have already been appointed and are working alongside the SALT Project Team at Sutherland. This is a mutually beneficial situation in which maximum knowledge transfer from the construction team to the operations team can take place. In addition the operations staff are actively began in assisting in the maintenance, test and commissioning of SALT subsystems.

SPIE CONFERENCE 2004

A delegation from SALT and SAAO took part in the international SPIE (The International Society for Optical Engineering) conference, Astronomical Telescopes and Instrumentation: The Industrial Revolution in Astronomy, held in Glasgow from 21-25 June, where a number of papers on SALT were presented. The SALT project update presentation was so well attended that people were prevented from entering the overfilled room that seats ~400 people. The talk had to be repeated later that afternoon in the main auditorium, together with a few other talks that also overfilled the room during previous sessions. These other talks included the OWL telescope, an ESO future telescope budgeted at ~1 billion Euros, the TMT, a USA project with a budget of ~700 million US dollars and three other projects with budgets ranging from ~150 to 500 million. It was interesting to note that SALT, with a telescope budget of 18 million USD, drew as much interest as these projects.

INTERNATIONAL COLLABORATIONS

Installation of the second "Superwasp" telescope, a joint project of several UK universities for monitoring the sky on a nightly basis, proceeded, with the placing of the order for its mounting platform. Completion is expected during winter 2005. Four cameras with large commercial lenses

will feed CCD detectors and preliminary reduction will be done automatically and on-line.

IT DIVISION

In December SAAO signed an agreement with TENET (Tertiary Education Network) to provide high-bandwidth access for data created by SALT. Under this agreement, both Sutherland and Cape Town sites will be connected to the GEN2 backbone by high-speed circuits. Data from SALT will be transmitted to SAAO Cape Town for pipeline processing and packaging and will be placed on the Telkom Beach-Head facility for availability to international SALT partners.

As part of the new network scheme, extensive changes had to be made to the internal IP address scheme and new firewall arrangements made. The changes at the Cape Town end were completed during the reporting period.

The Sutherland hostel was equipped with a wireless access point in mid-2004. A wireless network for the SAAO, Cape Town, campus is under construction.

INSTRUMENTATION DEVELOPMENTS

The reporting period saw the installation, commissioning and routine operation of a new CNC milling machine.

A CCD mosaicing facility capable of producing a mosaic flat to better than 20 micrometres was designed, made and put into operation.

The detector package for the SALT Prime Focus Imaging Spectrograph (PFIS) was completed and sent to the University of Wisconsin-Madison for integration into the instrument.

SALT COLLATERAL BENEFITS PROGRAMME

The SALT Collateral Benefits Plan is a programme of activities aimed at deriving maximum benefit form the existence of the Southern African Large Telescope (SALT). This report focuses only on the educational development activities implemented under the programme.

LEARNER DEVELOPMENT & SUPPORT

The purpose of this focus area is to engage learners in exciting hands-on learning opportunities that project science as fun and something that they ARE capable of doing. A total of 9 505 learners from around 168 schools were reached in learner-focused activities and initiatives this financial year.

Two Space Camps in July 2004 and March 2005 for 50 and 48 learners respectively were held, to expose learners to various experiences and activities, concepts and facilities in science and technology to enrich their knowledge and broaden their experience.

During National Science Week we partnered with the Discovery Centre to take their bus with Science exhibits to Sutherland thus giving access to 351 learners from 5 schools in the towns of Sutherland, Fraserburg and Williston. In addition, 372 learners participated in astronomy education activities at the Cape Town site of the SAAO.

A programme of Night Sky Viewing to the Cape Town site of the SAAO for school and youth groups was initiated. The Bergvliet Scouts and Athlone, Atlantis, Kensington and Grassy Park High Schools were the inaugural participants in this new initiative with 73 learners and 4 educators participating in an initiative aimed

Figure 14. Student interaction at a Science Club held at the SAAO Cape Town

at promoting astronomy education in schools. The ultimate aim is to have astronomy clubs established in at least some of the schools.

Science Clubs are a key mechanism to provide science learning opportunities outside of the restrictive class environment. The Education Officer (S. Manxoyi) led the interactions with and support of Science Clubs at schools in the Cape Town area with several workshops being held (Figure 13). The most active Science Clubs are to be found in the Phillipi, Gugulethu and Langa area. Four Science Clubs that the programme helped establish (at Sinethemba, ID Mkhize, Oscar Mpetha and Zisukhanyo High Schools have received financial support from the Shuttleworth Foundation. A DIY kit for establishing and maintaining a Science Club has been now been developed through the experience gathered thus far in this essential support function for schools.

The first Science, Engineering and Technology (SET) Careers Day was held on the grounds of the SAAO in Cape Town and was attended by 606 learners from both the Northern Cape and the Western Cape provinces.

Annually the Rutgers University Graduate School of Education (GSE) undertakes a study tour of South Africa. The SALT Collateral Benefits programme has linked up with the group to provide an opportunity for American teachers to share their experiences, skills and educational resources with educators in the Sutherland and Fraserburg schools.

We participated in 3 educational festivals in 3 provinces, namely the Namakwa Festival (NF) in the Northern Cape; the Grahamstown Science Festival (SciFest) in the Eastern Cape and the Learning Cape Festival (LCF) in the Western Cape.

The SAAO and the SCBP have joined the Cape Careers Exhibitors Association in order to expand the reach of activities particularly to rural areas that we have had no access to before.

Figure 15. Science, Engineering and Technology Careers Day held at SAAO, Cape Town.

A highly successful Transit of Venus programme was held by the SAAO in collaboration with other organizations on and around the 8th June. Between 400 and 500 people gathered at the SAAO in Cape Town to observe this once in a lifetime event.

A group of 150 learners were organized by the SALT Collateral Benefits Programme to attend Prof Tony Readhead's talk at the MTN Science Centre, as a way to expose learners to successful South African born scientists who have made a name for themselves internationally.

EDUCATOR DEVELOPMENT & SUPPORT

Four hundred and forty-seven educators were reached through direct technical workshops aimed at enhancing their content knowledge and teaching approaches for Science. A further 569 were reached through them accompanying learners participating in our initiatives.

A total of 22 educators from the Beaufort West area of the Western Cape graduated from a Technology Education training programme implemented in partnership with Ort-Tech and the South Cape/Karoo EMDC. Funding of R200 000 for this programme was obtained from the Telkom Foundation.

In a partnership with Ort-Tech and the Northern Cape Education Department's Namakwa district Office, an educator training project was implemented which involved about 25 Mathematics, Science & Technology educators from the towns of Sutherland, Fraserburg, and Williston. Funding worth R175 000 was provided by the DG Murray Trust. Two different groups of Science educators were supported to attend SciFest and the South African Institute of Physics Conference Education session.

The annual MST Education Seminar was held in Simonstown and attended by 60 MST educators, education officials and experts in the area of MST education.

PARTNERSHIPS

Our partnership with Ort-Tech for educator training and development in MST grows in depth every year. The graduation of 22 educators this financial year in Technology Education is a case

Figure 16. Maths & Science Educators seminar held in Simonstown.

in point. This year we also partnered with the Primary Science Project (Western Cape) in their primary school Science educator training , where our role was a focus on introducing astronomy content. The Discovery Centre Trust partnered us during National Science Week to take Science exhibits in their DiscoveryMobile to Sutherland, Fraserburg and Williston schools for the first time. In addition we are implementing a project to train Science educators in the same towns (plus Calvinia) to produce their own resource materials around electromagnetism. That project is funded by the Department of Science & Technology to the tune of R165 000.

STOBIE-SALT PHD SCHOLARSHIPS IN ASTRONOMY

In the past year an awardee, Ms Bonita de Swardt, returned from Rutgers University with an M.Phil in Astrophysics. She will continue her doctoral studies at the University of Cape Town. Ms Retha Pretorius was chosen as the Stobie-SALT scholar to go to Southampton University. She joins there Ms Vanessa McBride who is now in her third year of doctoral study. The local doctoral study scholarships were awarded to Mr Edward Jurua, to do a sandwich programme between the SAAO and Free State University; as well as to Mr Kaushal Khadaroo of Mauritius.

NASSP

SAAO contributes a major part of the effort involved in the National Astrophysics and Space Science Programme. Kilkenny organized the course "Observational Techniques, with contributions from O'Donoghue, Martinez, Buckley, Glass, Potter & Carter. Balona gives a course on "Computational Methods" and Romero gives "General Astrophysics II". In addition, SAAO staff supervise a number of student projects, including MSc theses.

Public Awareness Statistics 2004/05

Month	Queries		In the News		Press Releases	Broadcast Media	
	*	**	SAAO/SALT				
	Quick	10 min+	Brief	Feature		Radio	TV
April 2004	121	18	19	3	1	3	0
May 2004	132	25	15	10	3	4	0
June 2004	113	10	21	1	2	1	1
July 2004	195	13	8	0	1	3	1
August 2004	159	21	10	7	1	3	3
September 2004	157	6	17	7	2	1	3
October 2004	149	14	22	1	3	2	3
November 2004	150	10	3	3	3	4	0
December 2004	80	7	6	6	1	0	0
January 2005	111	13	17	5	2	3	0
February 2005	146	14	13	6	1	1	0
March 2005	135	10	11	1	1	0	1
TOTAL	**1648**	**161**	**162**	**51**	**21**	**25**	**12**

- *Queries answered immediately (under 10 min) ** Queries requiring more than 10 min research.
- "In the News" indicates the number of articles published in the popular press or general scientific literature that mention SALT, SAAO or its staff.
- SAAO subscribes to a news service, News Clip, who provides a good coverage of articles on SAAO or SALT that are published in SA print and broadcast media.
- There are sure to be many articles that appeared in the overseas press for which we have no record.