Anglo-Australian Observatory

Annual Report
of the Anglo-Australian Telescope Board

1 July 2004 to 30 June 2005

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Cover: Dome of the UK Schmidt Telescope. Photo courtesy Shaun Amy. Combined H-alpha and Red colour mosaic image of the Vela Supernova remnant taken from several AAO/UK Schmidt Telescope H-alpha survey fields. Image produced by Mike Read and Quentin Parker

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The Honourable Dr Brendan Nelson, MP,
Minister for Education, Science and Training
Government of the Commonwealth of Australia

The Right Honourable Alan Johnson, MP,
Secretary of State for Trade and Industry,
Government of the United Kingdom of Great Britain
and Northern Ireland

In accordance with Article 8 of the Agreement between the Australian Government and the Government of the United Kingdom to provide for the establishment and operation of an optical telescope at Siding Spring Mountain in the state of New South Wales, I present herewith a report by the Anglo-Australian Telescope Board for the year from 1 July 2004 to 30 June 2005. The report summarises the operations of the Board for the period under review and includes financial statements and statements of estimated expenditure in accordance with the provisions of the Agreement.

Pat Roche.

P Roche
Chair
Anglo-Australian Telescope Board

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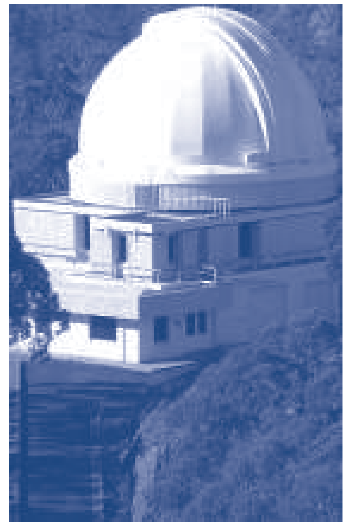
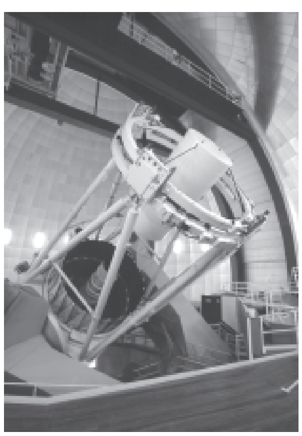
1 About the AAO



Statement of purpose

The Anglo-Australian Observatory (AAO) provides world-class optical and infrared observing facilities enabling Australian and British astronomers to do excellent science. The AAO is a world leader in astronomical research and in the development of innovative telescope instrumentation. It also takes a leading role in the formulation of long-term plans for astronomy in Australia and the United Kingdom.

History and governing legislation



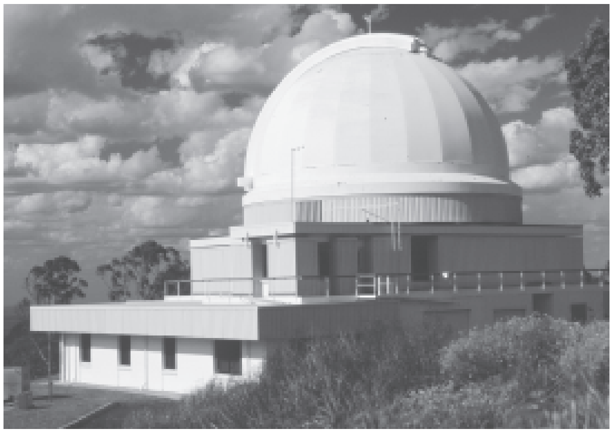
In 1969 the governments of Britain and Australia decided to establish and operate a large optical telescope in Australia for use by Australian and British astronomers. The *Anglo-Australian Telescope Agreement Act 1970,* which came into effect in February 1971, gave effect to this decision. The Act established the Anglo-Australian Telescope

The Anglo-Australian Telescope, (photo: Shaun Amy)

Board (AATB) as the independent bi-national entity that owns and operates the telescope, with funding provided equally by the Governments of Australia and the United Kingdom.

The 3.9-metre Anglo-Australian Telescope (AAT) was opened in 1974 on Siding Spring Mountain near Coonabarabran in north-west NSW. In 1988, the operation of another telescope on the same site, the 1.2-metre UK Schmidt Telescope (UKST), was transferred to the AATB. These two telescopes, together with the Epping headquarters facility and instrumentation laboratory, collectively form the Anglo-Australian Observatory (AAO).

The UK Schmidt Telescope at Siding Spring Mountain, (photo: Shaun Amy)



The Anglo-Australian Telescope at Siding Spring Mountain, (photo: Shaun Amy)

The AAO laboratory, Epping (photo: Urs Klauser)

Ministers responsible

The Minister responsible for the AAT Board in the United Kingdom is The Right Hon. Alan Johnson, MP as Secretary of State for Trade and Industry.

The Minister responsible in Australia is The Hon. Dr Brendan Nelson MP, Minister for Education, Science and Training.

Structure of the AAO

The AAT Board oversees the operations of the AAO. The Observatory has active and internationally recognised research, instrument science and instrumentation groups. Figure 1.1 shows the structure of the AAO. These groups are critical to the maintenance and the day-to-day operations of both the telescopes and to the development of state-of-the-art instrumentation. A small administration group supports the operations of the Observatory.

Designated agencies

Pursuant to Article 1 (2) of the Anglo-Australian Telescope Agreement, each Government acts through an agency designated for the purpose. These Designated Agencies are the Australian Department of Education, Science and Training (DEST) and the Particle Physics and Astronomy Research Council (PPARC) of the United Kingdom. These agencies are jointly responsible for implementing the Agreement. One Board member from each country has been nominated to represent their respective Designated Agency on matters relating to the Agreement.

AAO Director

The AAO Director, Dr Matthew Colless, is responsible for the successful operation of the telescopes, for providing the best possible facilities for all telescope users and for ensuring that the Observatory maintains its high standing in the international scientific community. The Director also actively pursues his own scientific research. In 2004 Dr Colless became a Fellow of the Australian Academy of Science.

Audit and Risk Management Committee

The AAT Board has established the Audit and Risk Management Committee to improve its corporate governance. Details of the Committee are included in Appendix D.

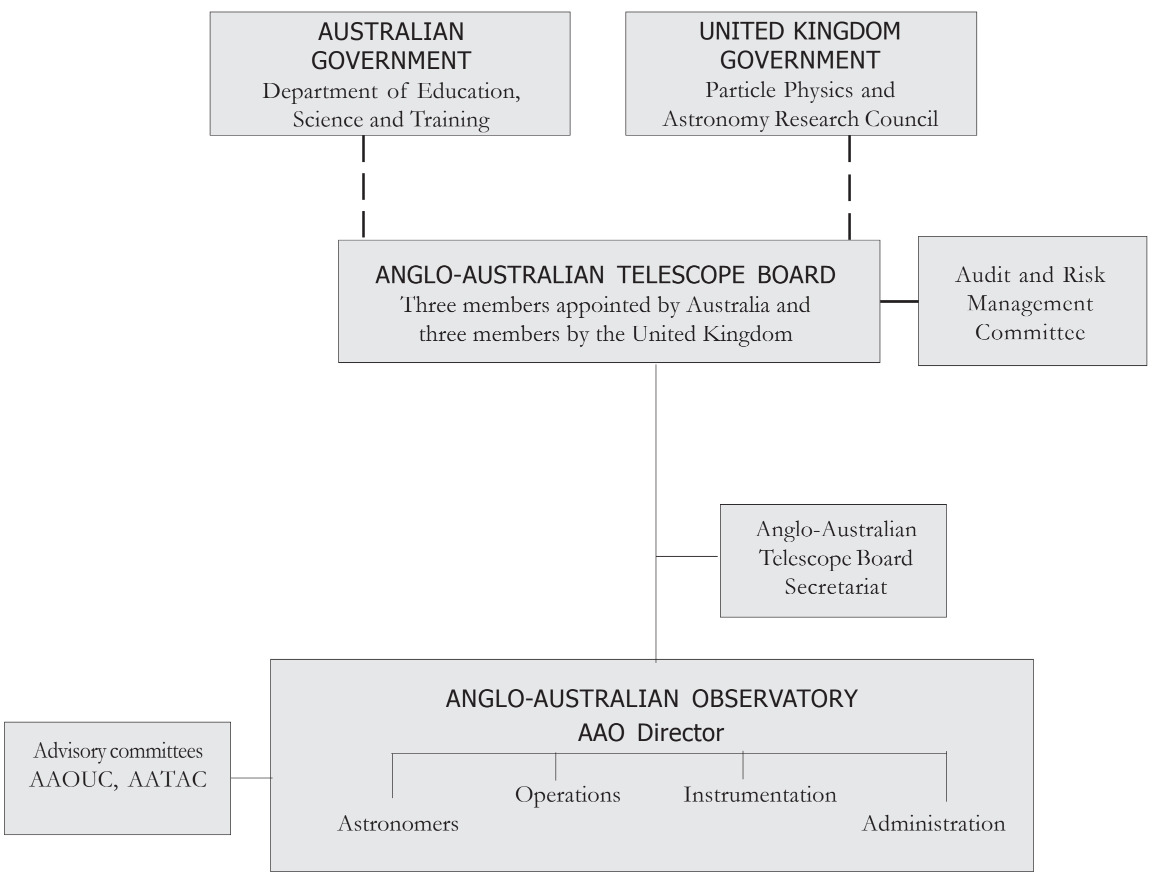
Advisory committees

The Anglo-Australian Observatory Users' Committee (AAOUC) advises the Director on aspects of the Observatory's operation.

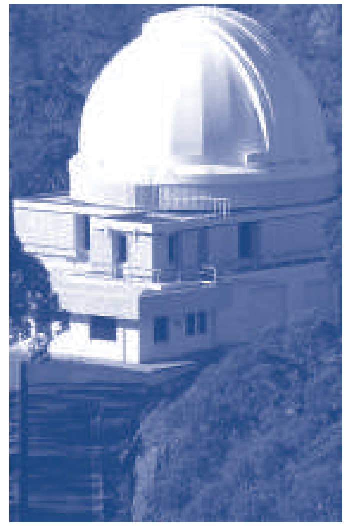
Observing time on the AAT is allocated by two national committees: the Australian Time Assignment Committee (ATAC) and the UK Panel for the Allocation of Telescope Time (PATT).

Details of these committees are included in Appendix D.

Figure 1.1 General structure of the AAO



2 The Year in Review



Dr Matthew Colless, FAA
Director of the AAO

Review by the Director

Purpose and Impact

Each semester the AAO telescopes typically provide observing time to between 50 and 60 research programs. These programs involve between 150 and 250 astronomers, of whom about 40% are Australian, 40% are British and 20% are from other countries. Time on the AAT is currently over-subscribed by a factor between 2 and 2.5, and this is likely to rise when the new AAOmega spectrograph becomes available in early 2006.

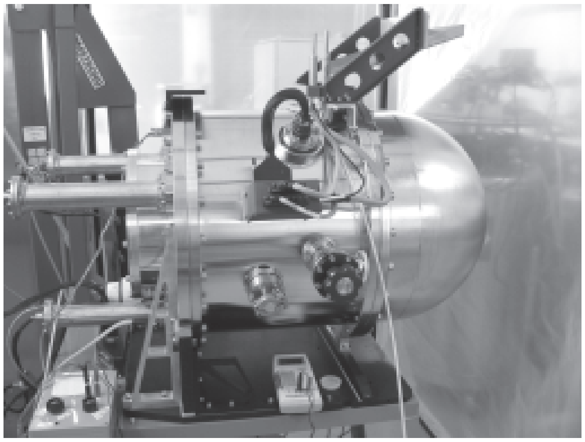
Over the last five years an average of 140 papers have been published each year from observations with the AAT or UKST. A review in 2000 by the European Southern Observatory showed that the publication rate from the AAT was among the highest of all the 4-metre class telescopes in the world. Many of the papers based on AAT or UKST data are highly cited in the scientific literature. For example, of the 300 most-cited papers produced by the international astronomical community over the last three years (the top 0.5% of all papers), 17 made use of the AAO's telescopes.

An analysis of the outstanding scientific impact of the AAO highlights the contributions of three critical elements.

First, the AAO provides top-quality service to the users of its facilities at reasonable cost. User feedback indicates high levels of satisfaction with most aspects of the AAO's service, and responsiveness to problems when they arise. This service is based on a relatively small but highly expert and dedicated group of support astronomers and technical staff. The recent streamlining of AAT operations has trimmed the staff lean while maintaining the high quality of support to users.

Second, the AAO's highly innovative instrumentation program keeps the telescopes on the crest of the technology wave. 2dF, 6dF and IRIS2 are all examples of instruments that have been successful because they have delivered performance advantages over the competition. This tradition will continue with AAOmega, the $3.7M successor to the highly productive 2dF facility. AAOmega will be the

"The most powerful instrument in the world for survey spectroscopy". AAOmega under construction (photo: Jurek Brzeski)



most powerful instrument in the world for survey spectroscopy when it begins observations in early 2006, and for several years thereafter. AAOmega will be used for several large observing programs and an array of smaller programs involving large numbers of astronomers. Effective exploitation of its capabilities during the coming decade will maintain the AAO's strong impact in survey astronomy.

Third, the AAO as an organization provides independence and diversity to the community it serves. As a bi-national institution it is outside the university systems, and can maintain a tight focus on delivering facilities for optical/infrared astronomy, a field in which Anglo-Australian astronomy is historically strong, which involves a large fraction of the research community, and which has a very exciting future.

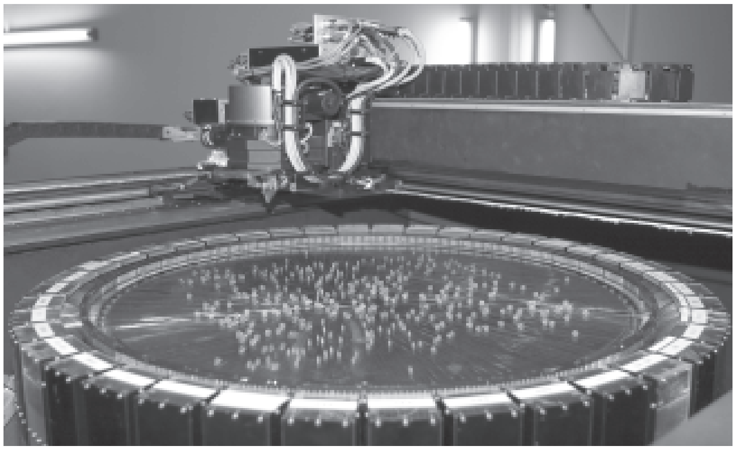
Science

In simultaneous press conferences sponsored by the American Astronomical Society and the Royal Astronomical Society, the teams carrying out the 2dF Galaxy Redshift Survey (carried out with the AAT) and Sloan Digital Sky Survey (using a telescope in the USA) announced on 12 January 2005 that they had both obtained clean detections of acoustic oscillations in their maps of the galaxy distribution. Although the two teams used different datasets and different analysis techniques, their results agreed remarkably well. The detection of acoustic oscillations, produced by the interaction of gravity, light, and ordinary matter less than 300,000 years after the Big Bang, is important scientifically because it confirms a strong prediction of the standard cosmology and because it provides a new ‘standard rod’ for measuring the geometry of the universe and probing the nature of the mysterious dark energy.

These results, and the manner in which they were obtained and announced, are also significant as an indication of one way in which the research culture of astronomy is evolving. Each of the two teams is a large, multi-researcher, multi-institution collaboration; both projects have been based on purpose-built instrumentation; both have taken a decade or more from conception to completion. Moreover, while the two groups have worked in competition at one level, at another there has been cooperation, as exemplified by the joint press releases. This trend towards larger and more collaborative research programs is an obvious feature of recent years, and has significant implications for how major observing facilities are run.

The importance of such large-scale research projects in addressing major scientific questions is apparent in the recent analysis of the productivity and impact of optical telescopes by Trimble et al. (2005, PASP, 117, 111). For the year (2001) studied by Trimble et al., the AAT and SDSS garnered by far the most citations of all the world’s optical telescopes below the 8-metre class – a factor of two more than their nearest rivals. Indeed, together they generated more citations than the 10-metre Keck telescope. While the AAT generated marginally more papers in 2001 than any other 4-metre class telescope, the telescope’s huge impact was mainly due to the very high citations per paper obtained by the 2dF Galaxy Redshift Survey and the 2dF QSO Redshift Survey. Of the 16 most-cited papers published in 2001 (jointly accounting for 10% of all citations), four came from 2dF while another three came from SDSS.

Results like these demonstrate clearly that medium-sized telescopes can have a major impact if they attack fundamental questions with cutting-edge instrumentation and generous allocations of time.



"Cutting edge instrumentation" like the 2dF field plate, has addressed major scientific questions (photo courtesy Shaun Amy)

Operations

Recognising this fact, the AAO is currently seeking to provide opportunities for exploiting the AAT's unique capabilities in large observing programs targeting major scientific questions. These programs can use any instrument, or combination of instruments, on the AAT, although the AAOmega spectrograph is clearly ideally suited to this mode of operation. AAOmega is expected to be available on the AAT from early 2006, and will be the world's most efficient instrument for large-scale survey spectroscopy for some years thereafter.

In early 2005, the AAO asked for expressions of interest in large observing programs and received 18 responses proposing programs requiring more than 2600 nights of AAT time. Most of these proposals sought to use AAOmega, but there were also programs asking for large amounts of time with other AAT instruments, including UCLES, IRIS2 and even UHRF. The topics addressed by the proposals ranged from planet-finding to high-redshift cosmology. The first large programs are expected to start on the AAT in early 2006, at the same time that the AAO is changing over to a single, unified time allocation committee.

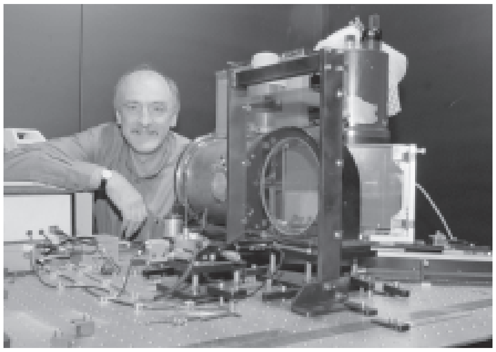
The proposed new Supplementary Agreement between Australia and the UK mandates the formation of a single Anglo-Australian Time Allocation Committee (AATAC) that will assign all time on the AAT in proportion to the partners' funding contributions. One of the major benefits conferred by a unified TAC is that it simplifies collaborative observing programs: there is no longer the double jeopardy involved in attempting to obtain time from both an Australian and a British TAC.

This will be a real boon for those proposing large programs, but should also encourage more collaborations between Australian and British astronomers across the board, ensuring that the best science programs are awarded all the time they require. Astronomy has long been an international undertaking, and this small step towards its globalisation will be of real value to all AAT users.

While large observing programs are just part of the mix of programs supported by the AAT, from the end of semester 2005A the UK Schmidt Telescope is reverting to something like its original role as a single-purpose telescope. Originally conceived to carry out photographic surveys of the southern sky, the UKST has in recent years carried out a varied mix of large surveys (such as the H-alpha photographic imaging survey and the 6dF spectroscopic galaxy survey) and smaller programs utilizing photography, fibre spectroscopy and CCD imaging.

Beginning in September 2005, however, the UKST will be largely dedicated to the RAVE (RAdial Velocity Experiment) project, which aims to measure the radial velocities, metallicities and abundances for hundreds of thousands of stars over a 5-year period. RAVE will be carried out on a user-pays basis, and is funded by grants obtained by

"Performance advantages over the competition". The 6dF spectrograph camera, a successful part of the AAO's highly innovative instrumentation program, pictured here with Dr Fred Watson, Astronomer in Charge (photo courtesy Shaun Amy)



members of the RAVE consortium. RAVE has already measured more than 50,000 stellar radial velocities (significantly more than the entire previous total) and will provide a superb map of the kinematical and chemical distribution of stars in the Milky Way, with a sample large enough to detect substructure in both the disk and the halo. Based on experience from previous large programs on the AAO telescopes, RAVE is expected to have a major impact.

Instrumentation

The AAO made a strong showing at the SPIE meeting on *Astronomical Telescopes and Instrumentation* held in July 2004 in Glasgow. AAO scientists and engineers presented 24 papers on topics ranging from the KAOS concept for a wide-field multi-object spectrograph on Gemini to novel designs for giant telescopes optimised to take advantage of the remarkable site characteristics found on the Antarctic plateau, and innovations in focal plane re-imaging using the AAO's Echidna, Starbug and Honeycomb concepts.

One AAO innovation is likely to have dramatic consequences for near-infrared ground-based observations. The near infrared is a crucial part of the spectrum in many fields of astronomy, but ground-based observations are severely hampered by the forest of strong atmospheric airglow emission lines that boost the effective background light by factors of a few tens. Over the past few years a lot of effort has gone into developing spectrographs and imagers that are capable of suppressing or avoiding these sky lines, but the various methods used all have significant disadvantages. Now a new approach, developed by the AAO, solves the problem by filtering out the narrow OH lines at high spectral resolution *before* their light enters the spectrograph or imager and is scattered. The technique, which uses aperiodic Bragg gratings imprinted in optical fibres, has the potential to revolutionize our ability to extract information from this important spectral domain. Although significant further development is needed, it is hoped that soon we will be able to see the universe in the near infrared with as little background as in the visible.

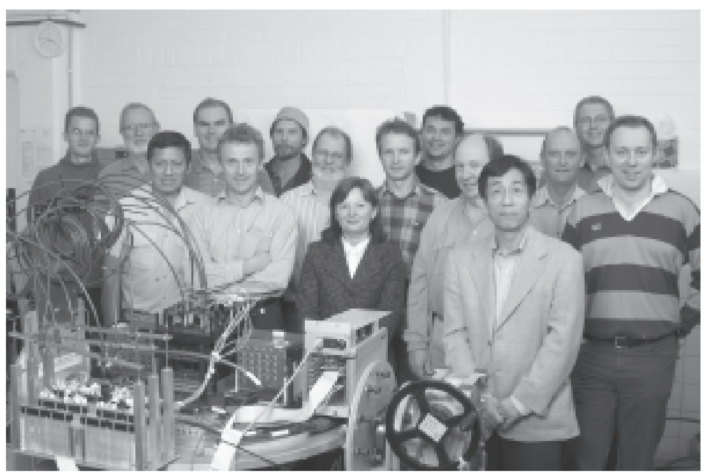
The AAO's major internal instrumentation project this year has been the new AAOmega spectrograph for the AAT, which is now well into the final stages of manufacture and assembly. AAOmega will be fed by both the 2dF fibre system and the SPIRAL IFU system, and offers very substantial gains over the existing 2dF spectrographs. The main gains are in throughput and resolution, with AAOmega being in all cases at least twice as efficient as the 2dF spectrographs (and up to a factor of six at high resolution and red wavelengths) and offering spectral resolving powers ranging from about 1500 to about 10,000 without compromising spectral coverage.

AAOmega is therefore a very powerful facility for survey spectroscopy. Taking the appropriate figure of merit to be survey speed (proportional to system efficiency times telescope aperture times field of view), AAOmega will be at least twice as good as 2dF, and significantly better than all other existing MOS systems, including 6dF on the UK SchmidtTelescope, GMOS on Gemini and FLAMES and VIMOS on the VLT. Moreover, AAOmega offers a wider range of spectral resolutions than most of these systems.

Strategic Outlook

The outstanding publication and citation rate from AAO astronomers, the high quality of service provided by AAO telescope staff, and the innovative ideas developed by AAO instrument scientists, all highlight the fact that an institution's main assets are the skills and abilities of its people. Although major new facilities such as Extremely Large Telescopes and the Square Kilometre Array will be important for the future, the most critical element will always be people: people who build innovative instruments for such facilities, people who use them to make scientific breakthroughs that allow us to better understand the universe, and people who by their teaching and research inspire students to take up science and engineering. Measured by its people the AAO is wealthy indeed, and has much to contribute in the coming decade.

"An institution's main assets are the skills and abilities of its people." Pictured here the AAO staff who designed and built the Echidna fibre positioner for FMOS on Subaru with Prof. Toshinori Maihara, left to right: Scott Smedley, Peter Gillingham, Dwight Horiuchi, David Correll, John Dawson, Neal Schirmer, Greg Smith, Gabriella Frost, Jurek Brzeski, Reuben Barnes, Sam Barden, Prof. Toshinori Maihara, Ed Penny, Rolf Muller, Scott Croom. (photo: David James)



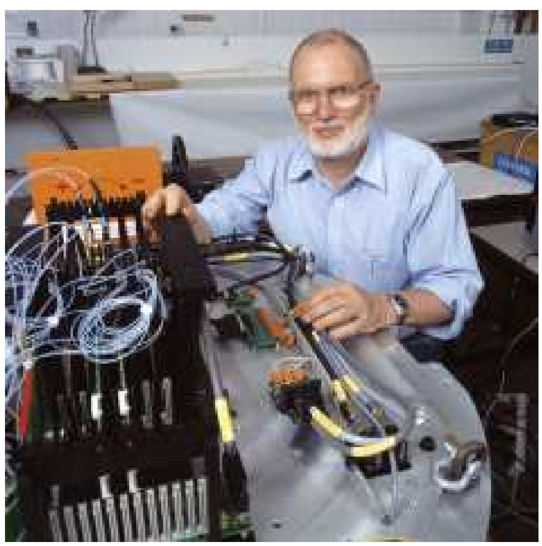
The AAT Board has six members, three appointed by each country, and the role of Chair and Deputy chair alternates between the two countries. Further details of Board members, special responsibilities and Board meetings are included in Appendix D. Pictured here are the current members of the AAT Board along with some members of the AAO Executive (from left) Mr Neville Legg, (Executive Officer), Mr Graham Brooks, Dr Mike Irwin, Dr Fred Watson (Astronomer in Charge), Dr Pat Roche (Chair AAT Board), Dr Matthew Colless (Director AAO), Dr Brian Schmidt, Prof Warrick Couch and Mr Greg Harper. Photo: Stuart Bebb, (Physics Photographic Unit, Oxford)

Review by the Chairman of the Board

Our view of the Universe has been transformed again over the last few years as results from space missions and ground-based telescopes have revealed new and unexpected twists in topics from cosmology to exosolar planetary systems. The contributions from the AAT to both of these fields, and many others, have been outstanding and demonstrate the excellence that has always been the hallmark of the observatory.

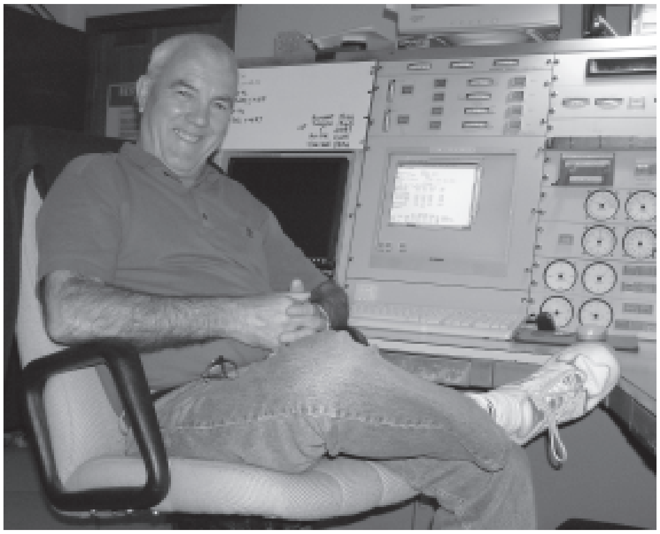
The expertise developed at the AAO through the early fibre-fed instruments, and especially 2dF and the innovative Echidna fibre positioner for FMOS, is a key ingredient of the proposal for the WFMOS instrument being designed for the Subaru 8-m telescope in Hawaii in a collaboration between the Gemini partnership and Japan. We congratulate the instrumentation group at AAO who, with their collaborators in the US and UK, have convinced the Gemini board of the potential and feasibility, and have driven WFMOS forward to the conceptual design phase. A number of other instrument programs are showing great promise and we are looking forward to the delivery to Coonabarabran of the AAOmega spectrograph later this year.

When the UK acceded to the European Southern Observatory in 2002, it was recognised that this would require significant changes to the funding of UK astronomical facilities. As part of this restructuring, PPARC announced that the UK would withdraw from the AAO in 2010. In order to allow an orderly transition from a jointly operated Australian-UK Observatory, to a wholly Australian operated facility, a supplementary agreement to the Anglo-Australian Telescope agreement has been agreed by the Board and is now being processed by the Australian and UK governments. The supplementary agreement will allow a gradual withdrawal of UK funding, with observing time to be shared according to the financial contributions of the two countries.



Peter Gillingham former optical engineer at the AAO, above, has retired after many years of telescope and instrument development. Pictured here with Echidna (photo: David James)

In response to these plans, the Australian astronomical community has set out its vision for the next decade in a report 'New Horizons: A Decadal Plan for Australian Astronomy 2006-2015', with a clearly defined role for the AAO, and we anticipate that DEST will convene an international review of the AAO to help plan its future. These changes make the exact form and role of the future AAO uncertain. However, the skills and expertise contained within the AAO are widely recognised both within Australia and internationally, and the AAO will undoubtedly continue to play leading roles in astronomy



Frank Freeman, above, former night assistant at the AAT has retired after 27 years (photo: Chris McCowage)

and astronomical instrumentation. This optimism is confirmed by the award of a substantial grant from the Australian and UK agencies, DEST and PPARC, to upgrade the fabric of the AAO buildings and bring them up to modern building code regulations.

The AAO staff have recognised this uncertainty and have agreed amendments to their working practices in the form of a new enterprise agreement; we are grateful for the cooperation of the whole observatory in this.

2005 is a pivotal year, where the structure that has served so well over the last 30 years is beginning to change. The operation of the UK Schmidt telescope is now funded by the RAVE consortium, an international collaboration to obtain spectra of many thousands of stars in our Galaxy, but it is still managed and operated by the AAO.

I end by noting some other very significant changes. A number of long-serving staff members, some of whom have worked at the AAO since observing began have retired or moved to other positions over the last year: Peter Gillingham has retired after many years of telescope and instrument development; Frank Freeman has retired after 27 years and many hundreds of nights; Joan Wilcox has retired as Executive Officer and Jeremy Bailey has moved full time to Macquarie University. To all the staff who have left in the last year we say farewell and thank you. The Board too has seen some changes; Profs Ron Ekers and Mark Birkinshaw have rotated off, and Brian Schmidt and Mike Irwin have joined, while Neville Legg has been appointed as Executive Officer.

Anglo-Australian Telescope Board 30 June 2005

Appointed by the UK Government

Chair
Dr P Roche, Reader, Department of Astrophysics, Oxford University; appointed 1 January 2003 till 31 December 2006

Dr M Irwin, Director, Cambridge Astronomical Survey Unit, Institute of Astronomy, University of Cambridge; appointed 1 January 2005 till 31 December 2007

Mr G Brooks, Head of Astronomy Division, Particle Physics and Astronomy Research Council; (Indefinite appointment)

Appointed by the Australian Government

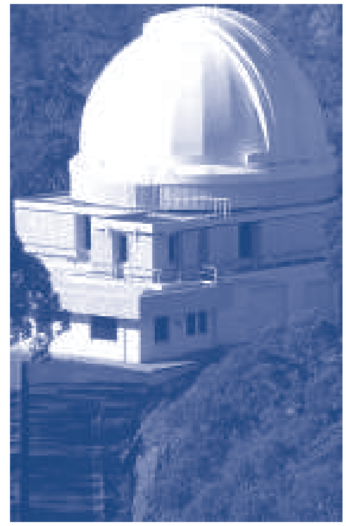
Deputy Chair
Professor W Couch, Head, School of Physics, University of New South Wales; appointed 5 November 2004 till 4 November 2006

Dr B Schmidt, ARC Professorial Fellow, Research School of Astronomy and Astrophysics, Australian National University; appointed 1 January 2005 till 31 December 2006

Mr G Harper Deputy CEO, Australian Research Council; appointed 5 November 2004 till 4 November 2006

Photos: Stuart Bebb (Physics Photographic Unit, Oxford)

3 Scientific Highlights



Galaxy patterns reveal missing link to Big Bang

A large consortium of astronomers from the AAO, RSAA, ATNF, UNSW and the UK have been involved in a 10-year effort to map the 3D distribution in space of 220,000 galaxies using 2dF on the AAT. This 2dF Galaxy Redshift Survey (2dFGRS) has been carried out by a team led by AAO Director Dr Matthew Colless and Prof. John Peacock of the University of Edinburgh. The survey is almost ten times larger than any previous such study. Observations for the survey ended in 2002, and the survey is already the richest source of AAO scientific papers to date.

In January, 2005, the 2dFGRS consortium announced that it had found the 'missing link' that directly relates modern galaxies like our own Milky Way to the hot Big Bang that created our Universe about 13.7 billion years ago. The survey measured in detail patterns in the distribution of galaxies, on scales from 10 million to 1 billion light-years. Subtle features in these patterns were set by physical processes that operated when the Universe was very young, and reveal the 'missing link' between present-day galaxies and the Big Bang. The 2dFGRS result has been independently corroborated by the US-led Sloan Digital Sky Survey (SDSS), which made use of a different method to obtain a consistent result.

Matching ripples

Theorists in the 1960s suggested that the primordial seeds of galaxies should be seen as ‘ripples’ – a pattern of hotter and cooler spots – in the cosmic microwave background (CMB). This CMB is heat radiation left over from the Big Bang. We see the CMB as it was when the Universe was only about 300,000 years old. The ripples in the CMB were first seen in 1992 by NASA’s COBE satellite, and revealed in greater detail by the WMAP satellite (see below). Until now, however, no-one had been able to definitely show how they were connected to galaxy formation. Astronomers use a statistic called the ‘power spectrum’ to mathematically describe the pattern of spots in the CMB. A plot of the power spectrum has peaks and troughs in it, and describes how the spots are clustered on different scales. The 2dFGRS team has produced the same kind of power spectrum for the galaxies that it mapped out, and for the first time found a high-confidence match between the galaxies and CMB power spectra. This confirms that gravity was the driving force that created today’s galaxies.

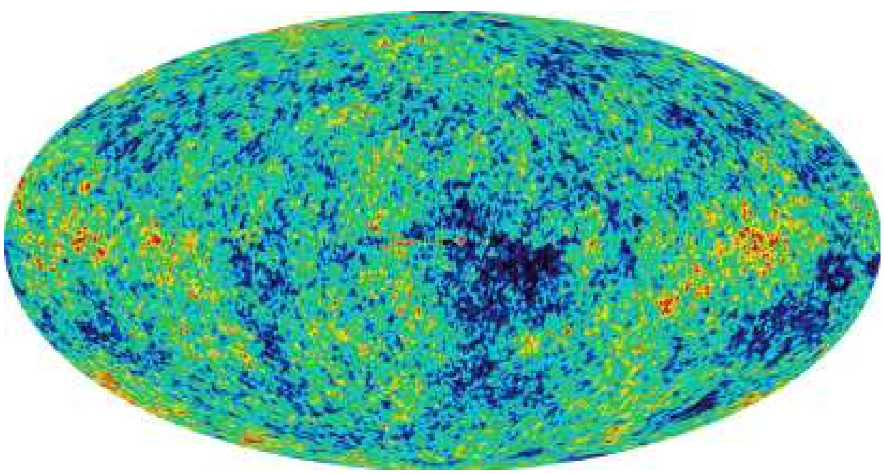
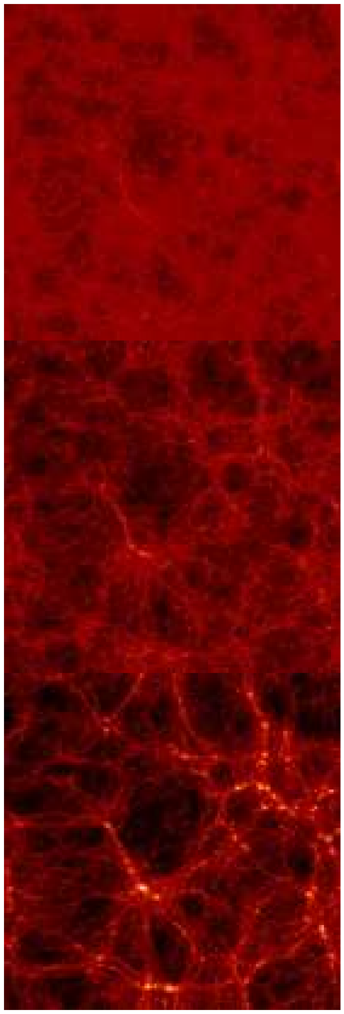


Image of the Cosmic Microwave Background, emitted 380,000 years after the Big Bang, (photo: WMAP Science Team / NASA)



Above: Computer simulation of matter forming into galaxies. The top picture is the furthest point back in time, redshift 3, the middle picture is a mid-point and the bottom picture simulates the structure at redshift zero, the present day. (photo: (c) Virgo Consortium)

Weighing the Universe

The same features in the power spectrum have also allowed the 2dFGRS team to 'weigh' the Universe with unprecedented accuracy. These features – called the "baryonic wiggles" – contain information about the contents of the Universe; in particular about the amount of ordinary matter – particles called baryons – that makes up stars, planets and people. The 2dFGRS has shown that baryons are a small component of our Universe, making up a mere 18% of the total mass. The remaining 82% is dark matter. For the first time, the 2dFGRS team has measured the density of matter in the Universe with an uncertainty of less than 10%.

Furthermore, the 2dFGRS has also shown that all the mass in the Universe (both luminous and dark) is outweighed 4:1 by an even more exotic component called "vacuum energy" or "dark energy". This opposes gravity, causing the expansion of the Universe to speed up. This conclusion comes from combining 2dFGRS results with data on the cosmic microwave background radiation. The origin and identity of the dark energy remains one of the deepest mysteries of modern science. Astronomers believe they could find clues to the identity of dark energy by identifying baryon wiggles in the pattern of galaxies that existed when the Universe was half its present age. They are now planning huge galaxy surveys to do this.

The 6dF Galaxy Survey

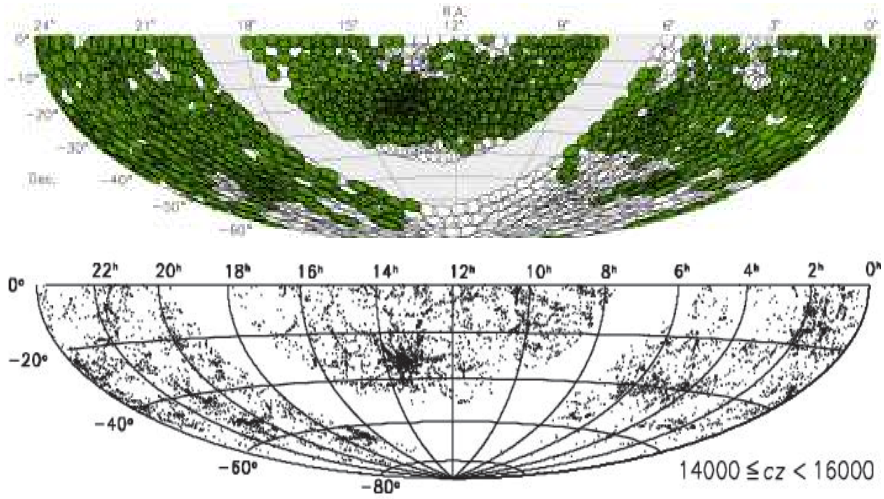
The measured velocity of a galaxy is a combination of the velocity due to the expansion of the universe (redshift), and its local motion due to the gravitational pull of neighbouring galaxies (peculiar velocity). The two facets of the 6dF Galaxy Survey (6dFGS) are a redshift survey of around 150,000 galaxies over the southern sky, and a peculiar velocity survey of a subset of 15,000 of these galaxies. When complete, it will be the largest survey of its kind by more than an order of magnitude. In terms of sky coverage, the 6dFGS will ultimately cover 8 times the area of the 2dF Galaxy Redshift Survey and twice that of the Sloan Digital Sky Survey.

Local mapping, galaxy formation and cosmology

The aims of the redshift survey are to investigate how galaxies are distributed by mass, luminosity, galaxy type and environment; to measure the clustering of galaxies on both small and large scales; and to further investigate cosmological measures of the universe like the power spectrum, and the large-scale structure of dark matter.

The peculiar velocity survey requires higher sensitivity measurements, and will provide a detailed mapping of galaxy velocities over a much larger area than ever before, covering about half of the local universe. The histories and properties of elliptical galaxies can be derived, spanning the smallest (dwarfs) to the most massive, which will be of key interest to modellers of galaxy formation. Finally, the "bias" of galaxies, or their number distribution compared to the distribution of total mass, can be measured to see how it varies with galaxy properties and environment.

Left: The Hydra cluster of galaxies, (photo: D. F. Malin, (c) AAO)



Top: The Second Data Release (DR2) takes its data from 936 fields. This figure shows that their distribution is true to the observing strategy adopted by 6dFGS from the outset: mid-latitude fields were tackled first, followed by those nearest the equator and finished with the polar targets. Bottom: Shows the distribution of DR2 redshifts on the sky for a small fraction of the total sample in the redshift slice indicated. Many local large-scale structures (such as the Shapley Supercluster) can be seen in what is the most detailed and comprehensive view of the southern local universe to date.

Public data release

In 2004 the 6dFGS team continued into the third year of this survey, which uses the fibre spectrograph 6dF on the UKST. Observing for the 6dFGS nominally finished on 31 July 2005, although some clean-up observations will take place during the remainder of 2005.

The 6dFGS data are made public at approximately yearly intervals, with Early and First Data Releases (DR1) having taken place in December 2002 and March 2004 respectively. Most recently, the Second Data Release (DR2) spans observations during the period January 2002 to October 2004, including and superseding DR1. It contains 89211 spectra that have yielded 83014 unique galaxy redshifts over roughly two-thirds of the southern sky. A total of 71627 sources now have their spectra, redshifts, near-infrared and optical photometry available online and searchable through a data-base at http://www-wfau.roe.ac.uk/6dFGS/. A third and final data release will be made in 2006.

RAVEing with the UK Schmidt

The largest catalogue of star velocities

RAVE is a major international project to measure the radial velocities (line-of-sight speed) and metallicities (chemical composition, linked to age) of up to a million stars in our Galaxy. The acronym stands for RAdial Velocity Experiment, and its end product will be new knowledge about the composition and history of our Galaxy, and a greater understanding of how other galaxies form.

The task is being accomplished with the AAO's 1.2 metre UK Schmidt Telescope. It will result in the largest catalogue of star velocities ever produced. Since the start of the project in April 2003, some 70,000 stars have been measured, more than twice the total number of measurements that existed before RAVE started.

A new direction for the UK Schmidt Telescope

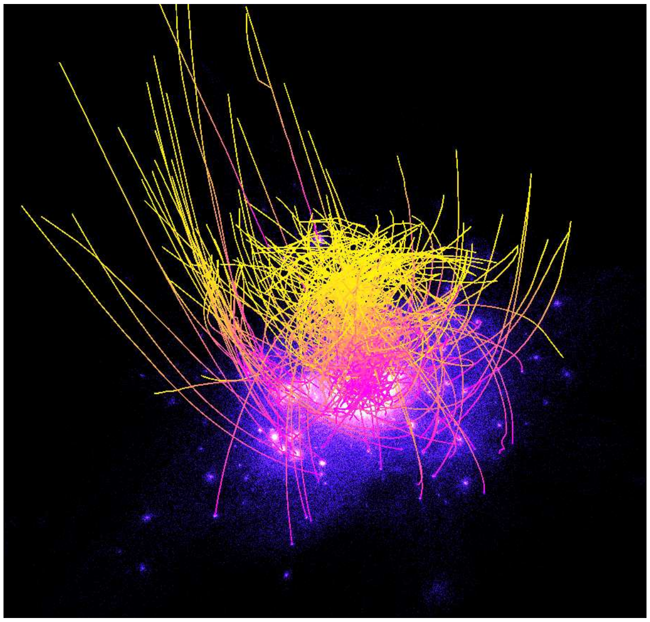
The recent completion of the UK Schmidt Telescope's other major project, the 6dF Galaxy Survey, has brought to an end the telescope's funding by the Australian and British governments. It now receives its operational funding entirely from the RAVE project, although the instrument will continue to be run by the AAO. RAVE observations now occupy the telescope full-time, and we expect to measure up to 130,000 stars per year. The project is supported by scientists from ten participating nations: Australia, Canada, France, Germany, Italy, the Netherlands, Slovenia, Switzerland, the UK and the USA.

The history of our Galaxy to be revealed

The scientific questions that RAVE scientists want to answer are centred on the dynamical history of our Galaxy – how the large-scale motions of stars have evolved to become the way we see them today. For example, the halo of our Galaxy (a spheroidal mass of stars, globular clusters and dark matter) is thought to have been formed by the disruption and accumulation of many small satellite galaxies. The stars that came from these devoured satellites still carry a memory of their origin with them in their orbits through space. Thus, analysis of the velocities of very large numbers of stars allows a kind of galactic archaeology to be carried out: stars with a common origin can be disentangled from the mass by their common velocities, and also their similar chemical signatures.

Weigh a spiral arm

In the broadest sense, RAVE is designed to allow a comparison of what we see in our Galaxy today with what simulations of galaxy formation predict. Other questions the survey will address include the chemical history of the Galaxy, the origin of the so-called ‘thick disk’ (a rarefied layer of stars above and below the main disk), and the origin of the bulge at the Galaxy’s nucleus. The idea of ‘weighing a spiral arm’ (by analysing the motions of stars within it) is also one that has caught the imagination of RAVErs, and will probably be one of the first significant results to come from the survey.



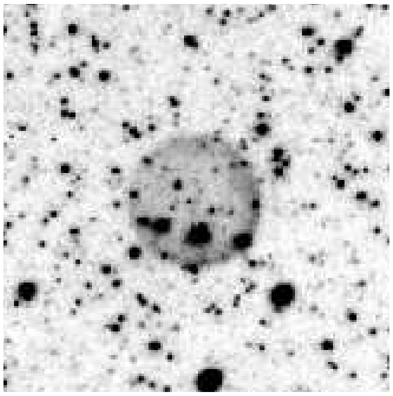
During its early history, dozens, if not hundreds, of satellite galaxies were in orbit around the Milky Way. As they are absorbed by our Galaxy, the satellites are torn apart by tidal effects. However, their member stars still retain the fossil memory of their original motion, shown here by the spaghetti-like flight paths of the satellites.

The AAO/UKST H-alpha Survey: A Rich Source of New Discoveries

The AAO's UK Schmidt Telescope (UKST) completed the H-alpha Survey of the Southern Galactic Plane and Magellanic Clouds in late 2003. A narrow-band filter was used to target hydrogen and nitrogen emission associated with hot gas and stars. This filter is the world's largest interference filter in use in astronomy. The survey was the last UKST wide-field photographic survey and the only one undertaken in a narrow-band. The survey covers a very large area of the sky (4000 square degrees) at high resolution and sensitivity. The original survey films were scanned by the SuperCOSMOS measuring machine at the Royal Observatory, Edinburgh (ROE), to provide the online digital atlas called the SuperCOSMOS H-alpha Survey (SHS), which is now an online digital data product of the Wide-Field Astronomy Unit of the ROE. A variety of programs are now underway to exploit the scientific potential of this new resource.

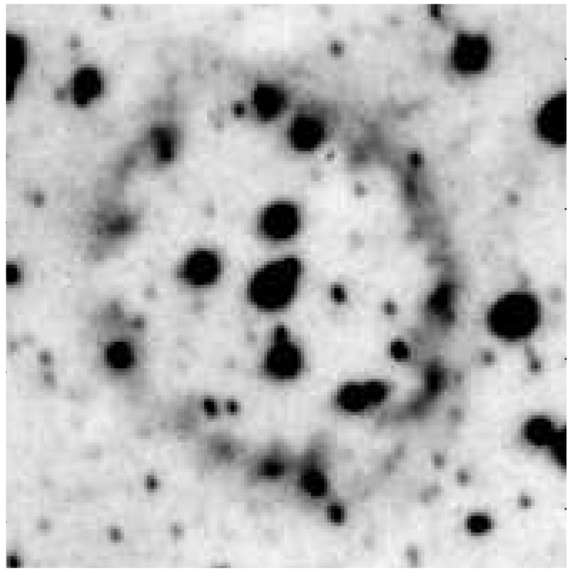
Greater understanding of Planetary Nebulae

The largest project arising from the AAO/UKST H-alpha survey has been the Macquarie/AAO/Strasbourg H-alpha planetary nebula project, led by Quentin Parker (AAO/Macquarie), which has uncovered about 1000 new Galactic planetary nebulae, nearly doubling the sample accrued from all sources over the last century. A planetary nebula is the end product of a low – to moderate-mass star, which expels its outer gas envelope to form a gaseous nebula around the star. Eventually the remaining star becomes a white dwarf. Other



Above: A newly discovered planetary nebula (PHR1706-3544) from the 3-hour – H-alpha survey data. This nebula is not visible in the standard broad-band surveys.

Right: The highly unusual ring nebula (PCG11) around a newly-discovered WN star. The ring has a regular scalloped appearance, with fingers of gas pointing towards the center. This is the pattern expected for a shell of gas which has undergone gravitational instability. This is the clearest and most complete example yet known.



discoveries of planetary nebulae (PNe) include: a possible new phase of PNe evolution; a very large PN in an early stage of interaction with the interstellar medium; two very large bipolar PNe previously misidentified as HII regions; and a new sample of old, highly evolved PNe which have spread out over a large area and are now very faint and difficult to find.

A wind-speed record and a scalloped shell

The SHS atlas has also been used to search for HII regions, or hot gas clouds, and the remnants of supernova explosions. Most recently, groups of astronomers have searched for emission line stars detected in the survey. Other methods of observation, such as spectroscopy, are used to classify and study these new objects. One particularly interesting object is just the fourth known massive WO star in the Milky Way Galaxy. These exceedingly rare stars are the most chemically extreme Wolf-Rayet stars, and they may explode as unusually powerful supernovae or even gamma-ray bursts. WO stars lose material in fast stellar winds, and the new star is estimated to hold the current wind-speed record for a non-degenerate star. Another interesting find is a WN star with a scalloped shell around it (see above). This highly regular pattern is due to gravitational instabilities, and while the effect is seen in other objects, the WN star is the only example of a *complete* shell of these instabilities, on any observable spatial scale.

Eclipsing binary stars in the Small Magellanic Cloud

The fuzzy patches of light in the night sky of the far Southern Hemisphere called the Magellanic Clouds are well known to be companion galaxies to the Milky Way Galaxy. The Large Magellanic Cloud (LMC), at a distance of about 50 kpc, and the Small Magellanic Cloud (SMC), at about 60 kpc, are sufficiently close to us to allow our present-day technology to provide separated images of stars in most parts of both galaxies. These satellite galaxies are important first steps in establishing the cosmological distance scale, because they allow us to use stellar distance calibrators that are well understood in our own Galaxy (e.g. Cepheid variable stars, red-giant stars, star clusters, eclipsing binaries) to determine their distances from us. Unfortunately, the various methods have not exactly agreed in the past, revealing systematic differences at the 10% level which most astronomers consider to be unsatisfactory.

Technological advances improve accuracy

Two technological advances of the past decade have allowed eclipsing binaries to be used as distance calibrators to nearby galaxies where the stars are faint because of their large distances from us. The MACHO and OGLE projects used arrays of CCD detectors mounted on small telescopes in Australia and Chile to obtain direct photometric images of the LMC and SMC. The by-product of both surveys was the discovery of large numbers of variable stars in both galaxies, including thousands of eclipsing binaries. The quality of the photometry was so good, and the MACHO and OGLE research teams so efficient, that the orbital periods of these binary stars were determined to 1 part in 100,000, and the resultant light curves were

Right: A photograph of the Small Magellanic Cloud (SMC) taken with the UKST (photo: AAO/ROE) defined to uncertainties of 1-2%. The second technological advance was the development of the multi-object spectrograph on the AAT known as 2dF. This instrument uses 400 optical fibres that may be positioned over a two-degree field of view (2dF) to receive the light from up to 400 individual stars and feed it through a spectrograph to record their separated spectra simultaneously, vastly increasing the observing efficiency.

Astrophysical properties found for 50 binaries

Ron Hilditch (St Andrews), Ian Howarth (UCL), and Tim Harries (Exeter) have carried out a project on eclipsing binaries in the SMC using the OGLE light-curve database and 2dF instrument to record thousands of spectra of more than 150 eclipsing binaries with orbital periods less than 5 days (that is, the two stars in each binary are close together, separated by only 1-2 stellar radii). They obtained enough spectroscopic observations on 50 eclipsing binaries to determine the orbital velocities of both stars in each binary. These results were combined with analyses of the binaries' OGLE light curves to determine the complete astrophysical parameters for each binary: that is, the masses, radii, temperatures and luminosities of both stars in each binary. The result is the largest single survey of the properties of intrinsically luminous high-mass binary stars ever achieved in any galaxy. These data are now being used as tests of the theories for the interactive evolution of stars in close binary systems in a galaxy with low heavy-element abundances and a different star formation history from our Galaxy.

Independent measures of distance to the SMC

The survey has also provided 50 independent measures of distance to the SMC, as the distance to each binary can be calculated directly from the binary parameters, with the usual correction for extinction. The SMC is a three-dimensional object which, from studies of Cepheid variables, may be approximated as a tilted rugby football shape with one end of the long axis about 14 kpc nearer to us than the other end. The eclipsing binaries were concentrated nearer the central parts of the galaxy where the line-of-sight depth is ~3 kpc according to the binary results and those of Cepheids. Hilditch, Howarth and Harries find a mean distance to the SMC of 60.6 +/- (1.0, 2.8) kpc (internal and external uncertainties), one of the most precise determinations to date. AAOmega, the new AAO instrument that supersedes 2dF, should allow the group to extend this work to many more eclipsing binaries in both the SMC and the LMC in the near future.

Sniffing out brown dwarfs

The discovery over the last ten years of over 150 planets orbiting other stars has excited astronomers and revolutionised our understanding of how planets form. Unfortunately, almost every single one of these planets has been detected by indirect means – that is, astronomers have not observed light coming from the planets themselves, but rather the effects those planets have on the light coming from their host star. As a result, although astronomers can estimate masses and orbital parameters for these planets, they can't study the planets themselves in the same way that they can study solar system planets.

Brown dwarfs the key to studying extrasolar planets

The best proxy for studying these "indirect" gas giant planets, with masses ranging from one-tenth to ten times that of Jupiter, are the objects known as "brown dwarfs". Brown dwarfs are failed stars – objects formed in the same way as stars, but with masses between 10 and 80 Jupiter masses, making them too small to ignite the nuclear reactions seen in stars. As a result they share many properties with gas giant planets. They are relatively cool (surface temperatures of 500-1500 degrees), very faint, and have highly complex atmospheres containing rich mixtures of molecules (e.g. water and methane) and dust.

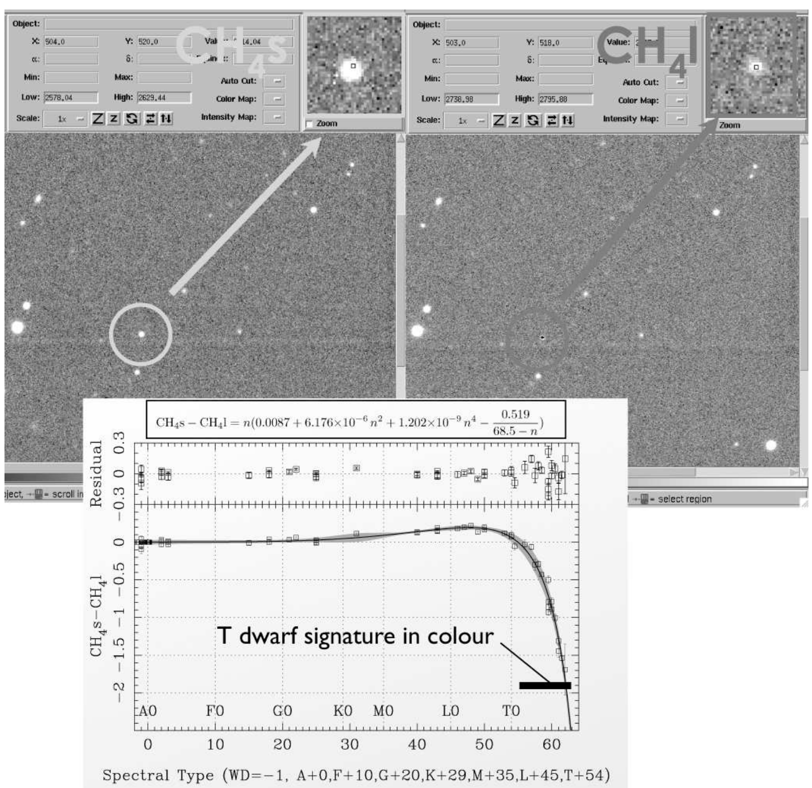
Unfortunately, finding brown dwarfs is almost as hard as finding extrasolar planets – they too only started to be discovered in the last decade, and there are now just a few hundred brown dwarfs known. The coolest and most interesting brown dwarfs are the hardest to find, and a lot of large telescope time has been used in the search for new examples.

Left: an artist's impression of how one of the new gas giant planets might look from one of its moons, (photo: (c) David A. Hardy / www.astroart.org)

Methane filters on IRIS2 reveal new T-dwarfs

Astronomers using the AAT have developed an entirely new way in which to hunt out these rare objects, using a dedicated set of methane filters installed in the IRIS2 instrument. These filters isolate the strong methane absorption bands seen in the coolest "T-type" brown dwarfs, allowing them to be readily separated from the rich background of much more numerous non-brown dwarfs. Moreover, not only do these filters identify these brown dwarfs, but the calibration system developed for the filters with IRIS2 allows their location within the sequence of T dwarfs to be immediately calculated. Using this new system, Chris Tinney and Simon Ellis of the AAO, together with collaborators Adam Burgasser (AMNH), Michael McElwain (UCLA) and Davy Kirkpatrick (IPAC), have identified and studied eleven new T-dwarfs, several of which lie in a new and potentially extremely important class of "K-band suppressed" T dwarfs.

Below: A section of sky observed through two different methane filters. While other stars stay much the same, the T-dwarf is much fainter in the right image, so it is easy to identify. (Inset): The graph panel shows how the difference between filters (or colours) can then be used to estimate the spectral type of the T dwarf from the hottest (T0) to the coolest (T8).



Asteroseismology of alpha Cen A

Asteroseismology, the measurement of stellar oscillations, is a beautiful physics experiment. A star is a gaseous sphere and can oscillate in many different modes. The frequencies of these oscillations depend on the sound speed inside the star, which in turn depends on density, temperature, rotation and chemical composition of the stellar interior. The five-minute oscillations in the Sun have provided a wealth of information about the solar interior. The Sun oscillates in many modes simultaneously and comparing the mode frequencies with theoretical calculations has led to significant revisions to solar models. It is widely expected that measuring oscillation frequencies in other stars will produce similar advances. Indeed, it is fair to say that theorists have been waiting eagerly - and with some frustration - for the first oscillation data to appear. The difficulty lies in the tiny amplitudes: only about 20 cm/s for the strongest modes in the Sun.

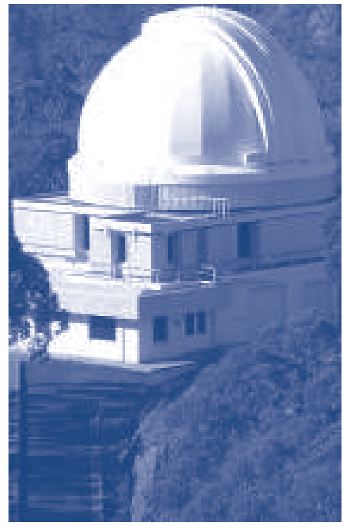
Oscillations observed in Sun's twin

T. Bedding (U. Sydney), R. P. Butler (Carnegie), H. C. Kjeldsen (Aarhus), C. McCarthy (Carnegie), G. W. Marcy (Berkeley), S. J. O'Toole (Erlangen), C. G. Tinney (AAO), and J. T. Wright (Berkeley) have observed oscillations in the star alpha Centauri A. This star is a near twin of the Sun but is slightly more massive, making it an excellent test for asteroseismology. Oscillations of alpha Cen A were first measured by Bouchy and Carrier using the CORALIE spectrograph in Chile. They were able to measure some of the oscillation frequencies, but with only one telescope they were limited by the ambiguities inherent in single-site data. Continuous coverage is important for disentangling the beating between different oscillation modes.

Most precise velocities ever measured

The new observations were made with both UCLES at the AAT and UVES at the VLT and were the most precise stellar velocities ever measured. This high velocity precision was obtained by using an iodine cell as a wavelength reference, the same technique that has been so successful in finding planets around other stars. It proved possible to extract frequencies for 42 separate oscillation modes and determine their amplitudes (most around 20-30 cm/s) and also to make the first estimate of mode lifetimes (slightly shorter than in the Sun). The group have since gone on to measure oscillations in the B component of this system, again with UCLES and UVES, and are now making detailed comparisons with theoretical models.

4 Performance



Telescope operations

Strategies

The AAO is committed to listening to the astronomical community, especially its user community, to assess and anticipate its needs. There are several avenues available for this. Principally, the time assignment committees, the AAO Users' Committee and the AAT Board (all representatives of the wider astronomical community in their own right) have a strong influence on the strategic directions of the AAO.

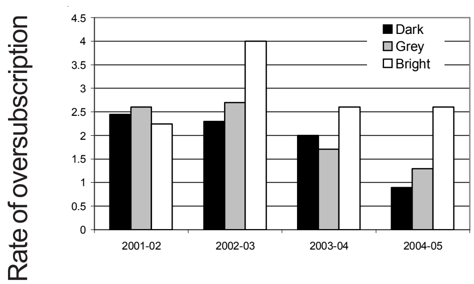
The AAO strives to stay abreast of world best practice, and AAO staff are encouraged to observe at or visit major telescopes overseas. Participation in conferences, seminars and colloquia are also important ways of staying in touch.

Another vital strategy is to ensure that the needs of users are met. This is achieved through maintaining and consolidating existing instrumentation and associated software; providing excellent support in setting up the instruments, operating the telescope, and observing; soliciting users' comments; continuing to develop first-rate, innovative new instrumentation; and achieving ever-greater efficiency in operating the telescopes.

AAT organisational statistics

It is the high standard of AAO facilities and the continuing instrumentation development program that have traditionally ensured that observing time on the AAT is over-subscribed. Figure 4.1 shows the oversubscription rate for the AAT over the past four years, sorted by lunar phase requirement.

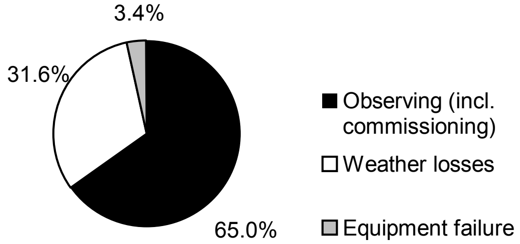
Figure 4.1 Oversubscription rates for the AAT



It will be seen that for the first time, the telescope is undersubscribed in dark time. This has a number of probable causes, the most significant of which is the likelihood that users are deferring their multi-object spectroscopy proposals until after the commissioning of AAOmega. The introduction of this new instrument is almost certain to introduce a significant spike in the oversubscription rate similar to that generated by IRIS2 when it was introduced during 2002–03 bright time.

AAT users come from a wide range of institutions in Australia, the UK, the USA and many other countries.

Figure 4.2 The use of observing time at the AAT in 2004-05



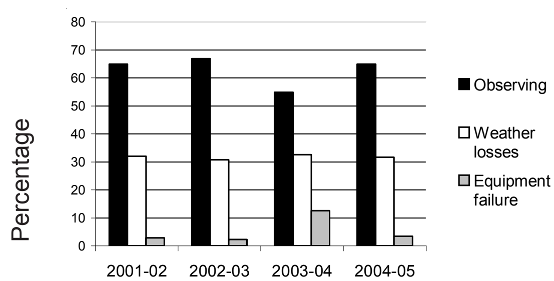
AAT performance indicators

Figure 4.2 shows the use of observing time during the period 1 July 2004 to 30 June 2005. A total of 3222 dark hours were available, and an additional 57 hours of commissioning time were used. The continuing trend of good weather conditions associated with the drought experienced in eastern Australia is evident in Figure 4.3, which compares the use of observing time over the past four years.

A critical metric of user satisfaction is the fraction of available observing time lost through equipment failure. It will be seen from Figure 4.3 that this has returned to typical levels following the time loss due to the catastrophic failure of a dome shutter drive shaft during 2003–04.

In fact, the reported level of 3.4% is still somewhat high, and ex-

Figure 4.3 The use of observing time at the AAT over the last four years



ceeds the AAO's target level of 3%. Analysis of AAT fault statistics reveals that the major contributor was 2dF, which experienced recurring robotic problems with the optical fibre positioner. These problems occurred mostly during the second half of 2004, and were dramatically reduced from the beginning of 2005 when new field plates were fitted to the instrument in preparation for the AAOmega upgrades. The performance of 2dF since then has been very much improved.

User Feedback

All AAT and UK Schmidt Telescope observers are encouraged to complete the web-based feedback form, which asks how well the AAO has fulfilled its obligations under its Client Service Charter (see Appendix C). The responses are ranked in five steps ranging from well below (1) to well above (5) acceptable. Users are also asked to flag key items and to comment on any issues of concern.

During the period 1 July 2004 to 30 June 2005, 65% of users completed feedback forms for the AAT. This response is higher than average (50–60%) and considerably higher than last year's (52%), which was affected by the extended down period caused by the dome shutter failure. Users are actively encouraged to submit feedback forms at the end of their observing runs.

The average scores over the year are shown in Table 4.1, together with those for the previous two years. The statistical error on these mean grades is ~0.2. They show that the level of satisfaction is generally high, and fairly consistent over the three years.

The AAO sets a goal of a score of at least 3.5 in all categories. All performance areas have met that target in 2004–05. General Computing, previously a weak area in the reply categories, shows promising signs of responding to the strategic IT initiatives. Many of the feedback reports contain suggestions for improvements, most of which have been acted upon. Usually they involve small, instrument-specific changes to improve ease of observing. All comments, both positive and negative, are followed up through appropriate management channels and acknowledged.

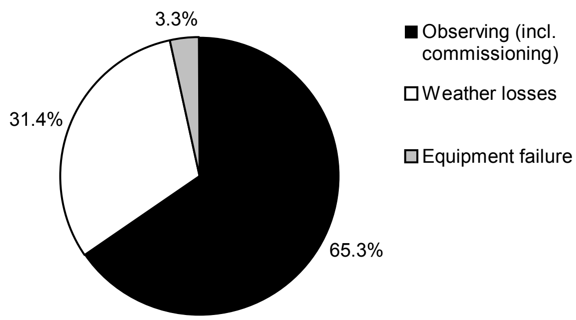
Table 4.1 User Feedback at the AAT

	2002–03	2003–04	2004–05
Night Assistant Support	4.7	4.7	4.8
Staff astronomer before	4.5	4.3	4.5
Staff astronomer during	4.6	4.5	4.6
Other technical support	4.3	4.1	4.2
Instrumentation & related software	3.8	3.7	4.0
General Computing	3.7	3.4	3.7
Working environment	3.8	3.9	3.9
Travel & Administrative support	4.4	4.1	4.0
Data reduction software	4.2	3.9	4.1
Instrument manuals	3.8	3.9	4.1
Library facilities	3.9	3.7	3.7
AAO WWW pages	3.9	4.0	4.1

UK Schmidt Telescope organisational statistics and performance indicators

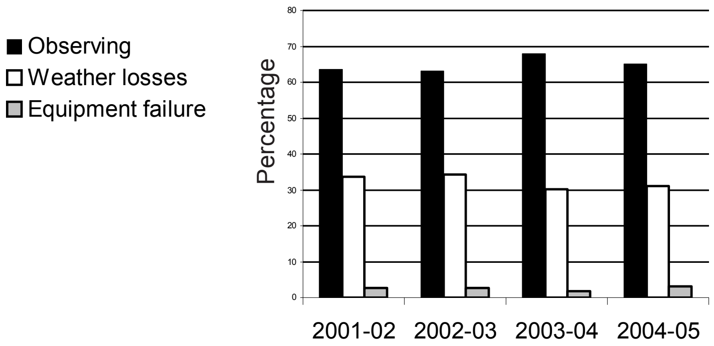
Figure 4.4 shows the use of UK Schmidt Telescope observing time during the period 1 July 2004 to 30 June 2005.

Figure 4.4 The use of observing time at the UKST in 2004-05



In Figure 4.5, the use of observing time over the past four years is shown, revealing once again the effect of continuing good weather.

Figure 4.5 The use of observing time at the UKST



System-loss statistics were slightly higher than usual in 2004–05 because of the loss of two complete nights during the period, one due to the failure of the 6dF guide-star camera (after 16 years of faultless service, initially with FLAIR II), and the other to the failure of an hour-angle drive amplifier. The 6dF instrument, now four years old, has attained a very stable operating mode with only ongoing fibre breakages presenting problems of reduced efficiency.

The 6dF program has occupied all UK Schmidt Telescope observing time since the beginning of 2003, and Table 4.2 summarises the data obtained for the principal observing campaigns since 6dF operations started.

Table 4.2 Total 6dF observations

	2001-02	2002-03	2003-04	2004-05
6dFGS fields	261	351	392	383
RAVE fields	–	47	320	407
Non-survey fields	124	162	118	112
Total fields	385	560	830	902
Total exposure	713	1078	1219	1288

6dF is an extremely labour-intensive instrument in use, involving a high level of physical involvement by the (solo) observer. The continuing improvement in observing efficiency revealed in Table 4.2 reflects outstanding performance on the part of UK Schmidt Telescope observers.

The 6dF Galaxy Survey (6dFGS) is now complete at right ascensions less than ~21h, and the remaining fields will be completed during Semester 05B. The fraction of scheduled observing time devoted to the 6dFGS was approximately 75%, the target recommended by the time allocation committees. A second data-release took place in April 2005.

Non-survey programs were also undertaken for the following principal investigators: Coates (UCL), Drew (Imperial), Fleenor (NC), Littlefair (Sheffield), Parker (Macquarie), Peyaud (Macquarie) and Vaughan (Macquarie).

Since 11 April 2003, seven unscheduled bright-of-moon nights per month have been allocated to the international RAVE survey of stellar radial velocities and metallicities (RAVE = RAdial Velocity Experiment), which funded the time externally. By the end of Semester 05A, 774 RAVE fields (telescope pointings) had been carried out, and a total of 68,422 spectra amassed. From 1 August 2005, however, all time on the UK Schmidt Telescope is available for RAVE (specifically 25 nights per month, of which 20 are supported by AAO observers).

Research

Research and organisational statistics

There were 11 research astronomers on the staff of the AAO at 30 June 2005. Five of them, while spending about half of their time on Observatory duties such as supporting visiting astronomers, spend the rest of their time on research. Three are members of the Instrument Science group and spend the majority of their time on research activities related to new instrumentation technologies. The other three, including the Director, the Astronomer-in-Charge and a shared position with Macquarie University, have significant responsibilities not directly related to their own research. The full-time equivalent research effort is about four people. In addition, there are two externally funded visiting astronomers, and two emeritus astronomers.

The total number of AAT observing programs for the past five years is shown in Figure 4.6.

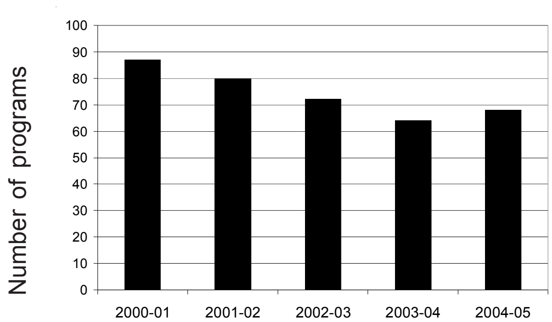
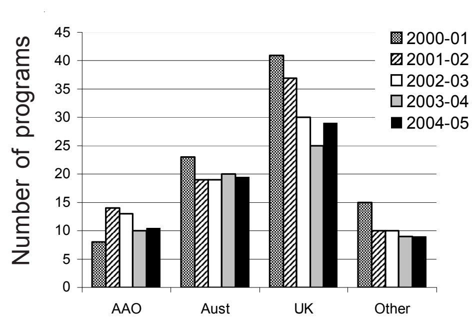


Figure 4.6 Total number of scheduled AAT observing programs. Note that long term proposals are counted for each semester they are scheduled

The long-term trend for a decreasing number of observing programs over the period is a consequence of policies to promote survey-style and longer-term programs at the AAT. Figure 4.7 shows the distribution of AAT observing programs by location of the Principal Investigator (P.I.).

Figure 4.7 Number of scheduled AAT observing programs by location of Principal Investigator



In Figure 4.8, the number of nights allocated at the AAT is distributed by the location of all the investigators in proportion. In both figures 4.8 and 4.9 we see that users from the U.K. continue to make active use of the telescope, although with a tendency to be the Principal Investigator less frequently. This may reflect the increasing use of the AAT for surveys, which are run by large consortia of astronomers. This also explains the large jump in percentage use by investigators from other countries, now the user group with the largest effective share of AAT time, despite the low numbers of programs with Principal Investigators from this group.

Figure 4.8 Percentage use of the AAT by location of all investigators

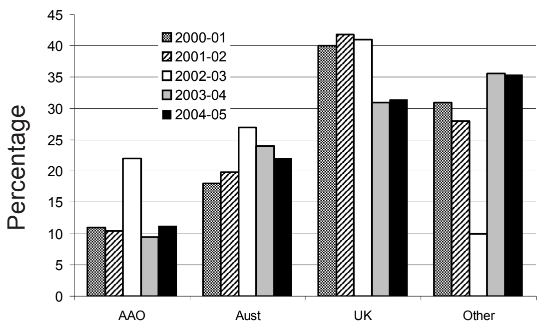
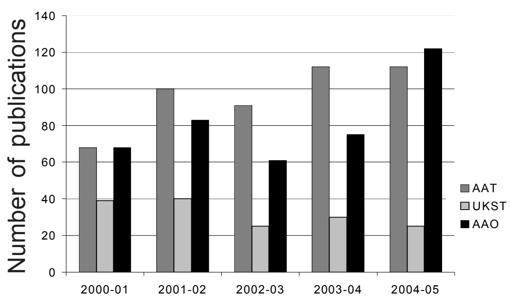


Figure 4.9 Total number of publications using AAT and UKST data, and AAO publications



This high level of international demand for the AAT in an increasingly international and competitive telescope "market" is seen as reflecting the Observatory's strengths in innovation and instrumentation. Figure 4.9 shows the total numbers of research papers published in refereed journals and conference proceedings using data from the AAT and the UKST. Also shown are the total number of AAO papers, published by AAO staff, students and visitors. In total, 112 AAT data papers, 25 UKST data papers and 122 AAO papers were published. AAT publications in this year have matched the all-time high reached in 2003–2004. The results from the 2dF redshift surveys are largely responsible for this, with a shift this year to a stream of secondary investigations based on the survey data.

AAO staff consistently produce a large number of high–quality publications, demonstrating the strong links between AAO astronomers and the international community, as well as the strong AAO involvement in surveys carried out with the Observatory's telescopes.

The distribution of publications in refereed journals by location of the P.I. is shown in Figures 4.10 and 4.11 for papers using AAT data and UKST data (respectively). Papers making use of UKST survey data

Figure 4.10 Research papers published using AAT data by location of First Author

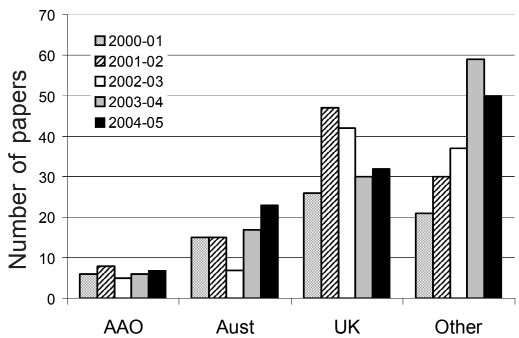
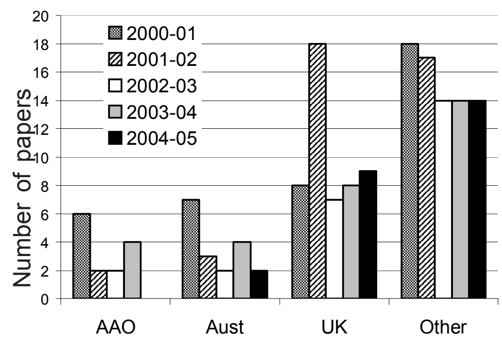


Figure 4.11 Research papers published using UK Schmidt data, by location of First Author.



only are not included. There is an increase in many areas and the AAT publications from other countries have continued strength due to secondary 2dF Survey papers. Figure 4.12 gives the number of AAO publications produced by staff, students and visitors, sorted by papers including AAT data, UKST data, and other papers. Publication numbers are strong in all areas, with particular growth in the 'Other' category boosted by large numbers of papers on new instrumentation technologies under development at the AAO. The trend to papers without AAT and UKST data continues but the number of AAT papers with AAO authors is also well up on previous years.

Figure 4.13 shows how well AAT observing programs are converted into scientific papers. To allow for the delay between observations and publications, the statistic given here is the number of publications in a given year divided by the number of proposals in the previous year. Typically between 0.7 and 1.0, this year sees an increase on the previous year's all-time high of 1.56 to 1.75 papers per program – another record. This figure reflects the impact of the move to survey observing programs, in the fact that the total number of observing programs has dropped, the longer time needed to complete and publish results from major surveys and the high rate of secondary research. Averaged over the past five years, an impressive rate of 1.26 papers per AAT observing program is being achieved.

Figure 4.12 AAO publications by AAO staff, students and visitors

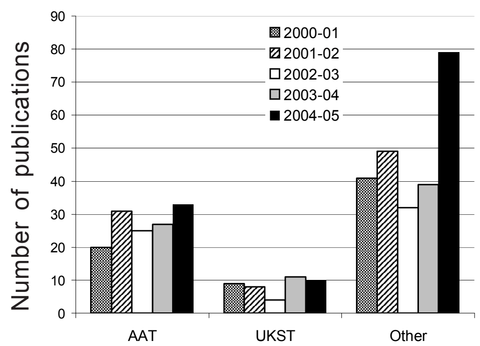
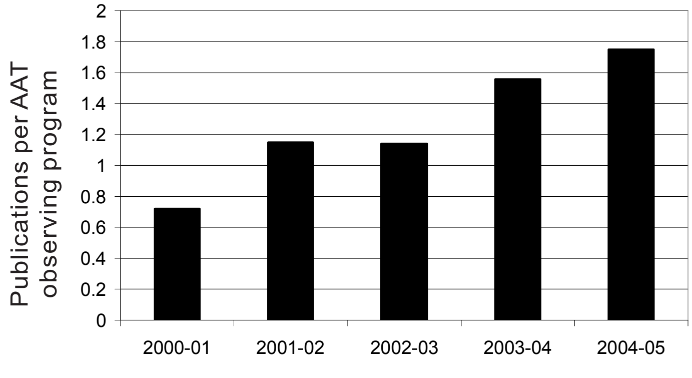


Figure 4.13 Publications per AAT observing program



Instrumentation

The AAO spends about 15 percent of its budget each year on new instruments and associated software and detectors. Table 4.3 summarises the use made of instruments on the AAT over the last few years.

Table 4.3 Use of AAT instruments for the last three years (% nights allocated).

Instrument	2002-03*	2003–04*	2004–05*
2dF	22.6	33.9	33.0
UCL coude echelle spectrographs (UCLES & UHRF)	29.7	23.9	31.3
Infrared imager/ spectrograph (IRIS2)	11.5	24.5	26.3
Wide field imager (WFI)	7.4	2.8	2.5
Taurus II & Taurus tunable filter (TTF)++	9.9	4.7	–
RGO spectrograph++	10.9	4.3	–
SPIRAL integral field spectrograph++	4.6	0	–
Instruments supplied by users	3.8	5.9	6.9

*Years indicated are not financial years, but two AAO Semesters running from 1 February to 31 July (A) and 1 August to 31 January (B).

++*TTF, RGO and SPIRAL were decommissioned in 2003–04.*

Observing time on the AAT is now split almost equally between the use of the Two-degree Field (2dF) multi-object spectrograph; the high-resolution optical spectrographs UCLES and UHRF; and the near-infrared imager and spectrograph IRIS2. A small fraction of the time is used by visiting instruments (notably the French-built Semel Polarimeter used in conjunction with UCLES) and the Wide-Field Imager (WFI) CCD camera shared with the Australian National University. Tests were also carried out with a new high-speed

WATEC video camera, allowing the AAT to record extremely sharp images of planets including Mars and Jupiter at times of low atmospheric turbulence.

Nearly half of the observing time with the UCLES spectrograph is now devoted to the search for extrasolar planets, with the rest going

Denis Whittard (left) and Vlad Churilov installing the liquid nitrogen can for AAOmega's blue camera, (photo: Jurek Brzeski)

to studies of the chemical composition or vibrational modes ("asteroseismology") of nearby stars. The past year has seen the completion of major galaxy and quasar redshift surveys with 2dF, in anticipation of even more ambitious surveys to begin in the following year with the new high-performance AAOmega spectrograph. IRIS2 has been kept busy with work on everything from low-mass brown dwarf stars within a few light years of our Sun, to radio galaxies at high redshift.

While 2dF, WFI, UHRF, and IRIS2 have their own dedicated electronic detectors, UCLES users may choose between either the blue sensitive EEV2, or the red-sensitive MITLL3. Both these detectors are now in routine use with the new AAO-2 controllers and a fully-fledged graphical user interface. The science-grade infrared array detector in IRIS2 suffered a catastrophic failure during a warm-up/cooldown process in May 2005. The manufacturer in the USA has agreed to replace this failed detector, and in the meantime an engineering-grade array is providing most of the functionality with only a slight loss in performance.

The coming year will see the introduction of the new general-purpose optical spectrograph AAOmega at the AAT, as well as the transition of the last remaining instruments to more modern control computers, as described in more detail in the following section.

Instrument Science

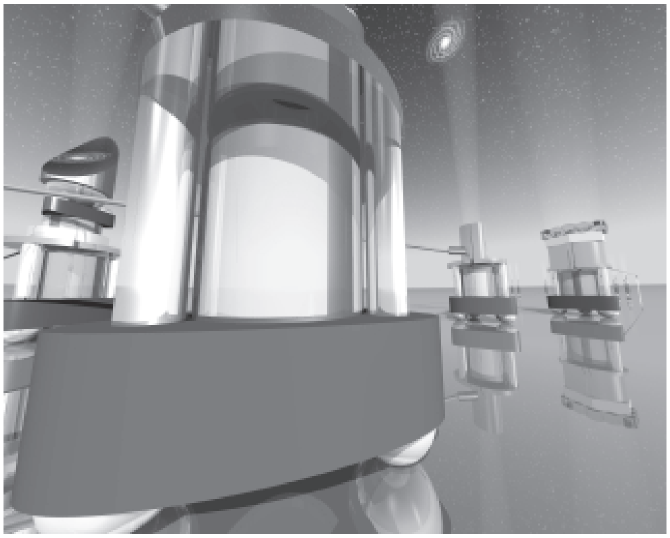
This has been a challenging year for the Instrument Science group. We have had to maintain our research and development against a backdrop of two staff members leaving the AAO (Bailey and Gillingham), and heavy involvement in major instrument developments, including AAOmega and FMOS, and major design studies (WFMOS). However, there have been notable successes in astrophotonics, the development of OH suppression technologies, autonomous robotic positioners (starbugs), and Antarctic technologies. The group was also involved in an industrial showcase and a highly successful series of presentations at the SPIE meeting (July 2004) in Glasgow, Scotland.

The group has continued to innovate and develop new spectrograph concepts and new uses for dispersion gratings. These include a double-pass grating for doubling the resolution of an existing volume-phase holographic grating, new designs for S- and P- phase optimized VPH gratings, and the commissioning of a “Dickson” VPH grating. We have also proposed the first instrument concept which allows for arbitrary formatting of a contiguous field, a device we call a honeycomb spectrograph. This device tiles the field with micro-IFUs which can be edge-butted on all sides.

We have continued to develop the starbug positioning technology, and prototyped a number of different bugs in both a temperate and cryogenic environment. We now envisage a wide range of uses for these bugs on 8m and extremely large telescopes, and are investigating wireless operation for locating and positioning. This work has been sponsored by an OPTICON FP6 grant in association with the Astronomy Technology Centre, Edinburgh.

We have continued our collaboration with the University of Durham on the development and investigation of astrophotonics, i.e. applications of photonics within astronomy. For the second year running, we were successful in attracting funds from the PPARC Innovative

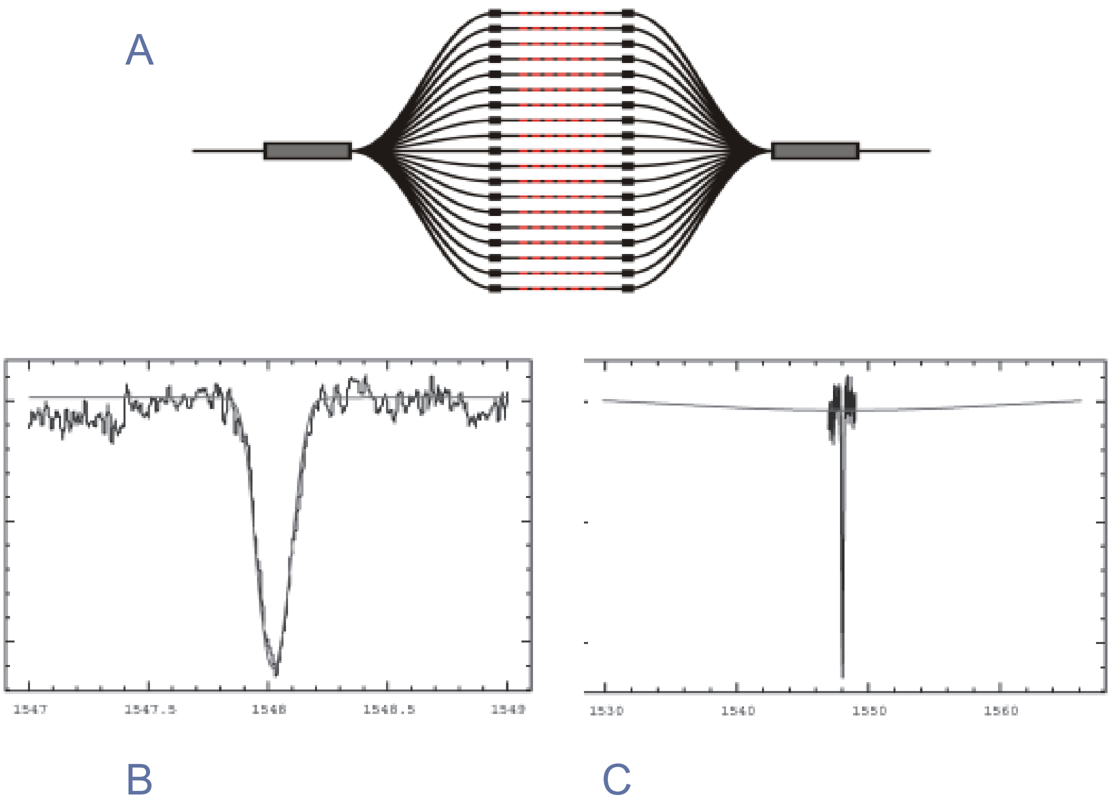
Research into robotic positioners (starbugs) aims, among other things, to develop positioners that are able to move autonomously across a magnetic focal plane (as envisaged in the diagram at right). Diagram: Andrew McGrath



Technology Scheme. We have identified optical fibres with improved blue performance, and these are to be utilized within AAOmega. We are currently investigating near- to mid-infrared fibres based on photonic crystal fibre technology, and fibre tapers for use within AAOmega.

This year brought us a step closer to achieving high performance OH suppression within an optical fibre. Last year, we demonstrated the potential of fibre Bragg gratings (FBGs) to knock out 36 OH emission lines in the H-band within a single mode fibre, work that was carried out in collaboration with Redfern Optical Components, Sydney. This year, in collaboration with the University of Bath, we recorded a major milestone by demonstrating the same principle within a multimode fibre, something that was thought to be impossible.

The group continues to pursue the development of Antarctic technologies. The University of NSW sponsored the AAO to investigate the use of photonic suppression to combat auroral emission, and to specify the design parameters of a proposed 2m telescope for Dome C. The group continues to be actively involved in telescope concepts for Antarctica.

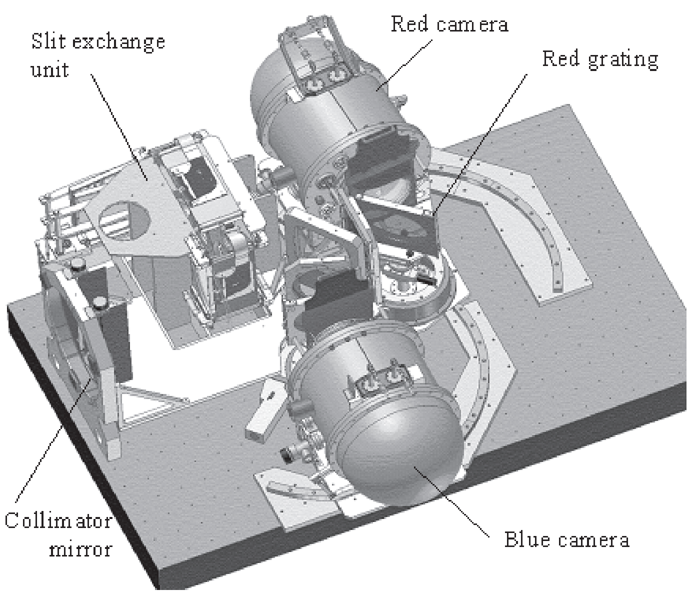


The first ever demonstration of a fibre Bragg grating in a multi–mode fibre. (A) The device used, a tapered multi–mode fibre (MMF) grating. The input multi–mode fibre (MMF; at left) is split into a number of single-mode fibres (SMFs; centre), each with identical fibre Bragg gratings imprinted on them. These SMFs are then merged back into the output MMF (at right). The couplings between the input and output MMFs and the SMFs with the fibre Bragg gratings is achieved via taper transitions. (B) The smooth curve is the notched response of one of the individual SMFs shown at A. The noisy curve is the measured response of the new device, and is essentially identical to the red curve within the notch (the noisy continuum structure is an artefact of the test equipment). (C) The noisy curve is the same as in B; the very broad smooth curve is the notched response of the same grating inserted into a MMF with the same aperture – the notch is broadened by a factor of 200 compared to B!

Current Instrumentation

AAOmega

The AAOmega project proposes to replace the two 2dF top–end–mounted fibre–fed spectrographs with a new bench mounted dual-beam spectrograph. Some upgrade work to the 2dF robotic fibre positioning system is also underway. The new spectrograph uses large format detectors, volume phase holographic gratings and will be able to carry out “red” and “blue” observation simultaneously, providing a facility that will enable much fainter and more detailed



Physical layout of AAOmega, showing the red camera in the high dispersion mode and the blue camera in low dispersion mode

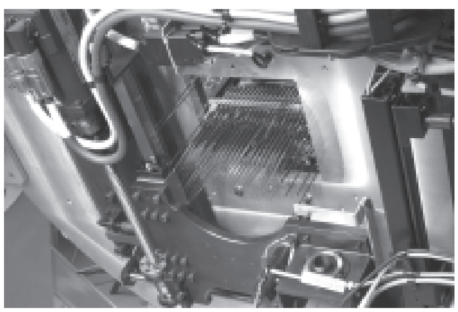
observations. The instrument is scheduled to be commissioned on the AAT at the end of calendar year 2005.

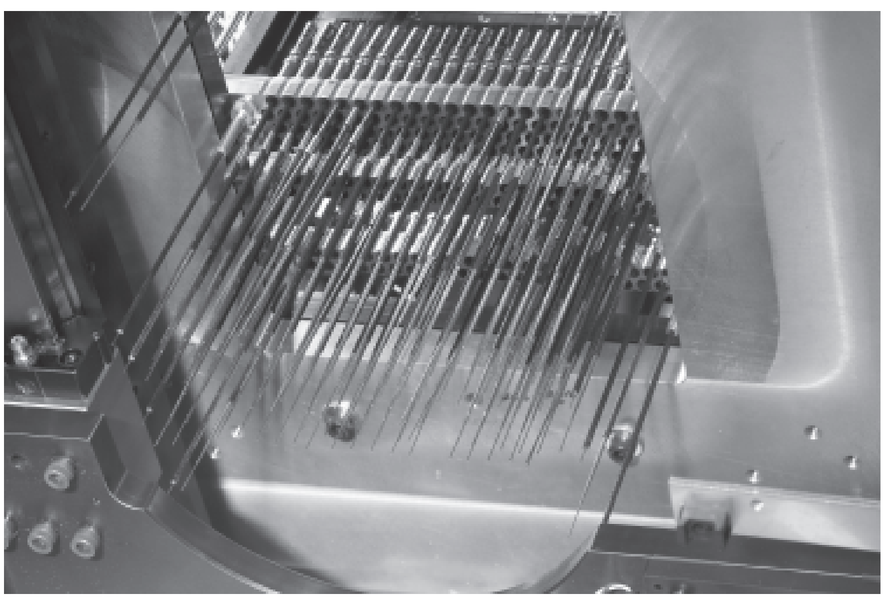
The AAOmega project underwent its final design review in the second half of 2004. The detailed design and fabrication proceeded very well with few problems. The instrument is currently under assembly and test.

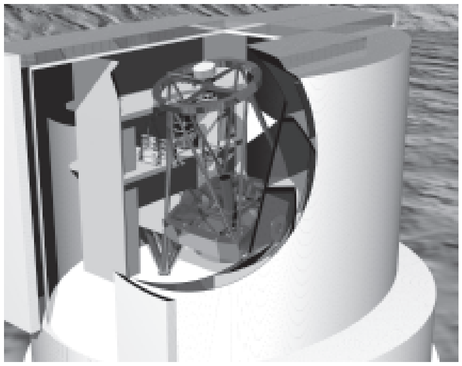
FMOS Echidna

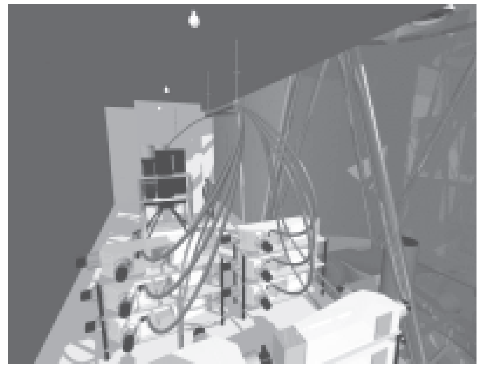
Echidna is a 400–fibre robotic positioning system for the Japanese Subaru telescope in Hawaii and is part of the FMOS system that will provide a highly–efficient near–infrared spectroscopic facility. The principle of operation for Echidna is different from 2dF, 6dF and OzPoz, in that all 400 fibres can be moved simultaneously to their required positions. The project is currently in the assembly and test stage. Delivery to Subaru should take place in the second quarter of 2006.

FMOS Echidna, a 400 fibre robotic positioning system for the Japanese Subaru telescope. Below right, Scott Smedley pictured with the Echidna unit. Below left, Echidna spines in the context of the instrument, and at the bottom close up of the spines that give the instrument its name, (photos: David James)









The figure at top left shows a view of the implementation of WFMOS on the Subaru telescope, with an Echidna style positioner located at the prime focus of the Subaru telescope. The fibre cable drapes off the telescope and enters a spectrograph chamber, shown top right. 1500 fibres feed into a set of high-dispersion spectrographs that will provide a resolving power of 40,000. An additional set of 3000 fibres feed into a bank of low-dispersion spectrographs for low-resolution surveys (diagrams: Andrew McGrath) Bottom. Members of the WFMOS team at the feasibility study review. Chris Evans, (AAO) Bob Nichol (Portsmouth) Sam Barden (AAO) and Arjun Dey (NOAO) are pictured here at the Gemini Observatory in Hilo (photo: Chris Evans).

WFMOS

The AAO led a collaboration, including the US National Optical Astronomy Observatory, Johns Hopkins University, University of Portsmouth, University of Oxford, University of Durham, and the Canadian Astronomical Data Centre, to examine the feasibility of a very wide field (1.5 degree), highly multiplexed (4500 fibers) multi-object spectrograph for the Gemini Observatory. The concept builds upon the Echidna technology. Two telescope platforms were investigated, Gemini and Subaru. The WFMOS feasibility study came to a close with a successful review in Hilo in March 2005. Gemini is now currently soliciting proposals for the next phase, a conceptual design study.

Optical Detector Controllers (ODC)

The ODC project to implement the AAO2 Detector Controllers is officially complete and a post–project review was held in May 2005. These controllers now operate all CCD and IR detectors at the AAT.

Telescope Control System (TCS) and Instrument Control and Integration (ICI)

The telescope control system (TCS) project is to implement a replacement of the original Interdata computer system. Although the current system is very reliable, the Interdata computer is obsolete and replacement parts are very difficult to find. The new system will implement a modern computer platform, but will retain the same functionality. The project had a successful design review nearly a year ago. Completion is expected to take place by mid-2007.

A related project (ICI) is also underway to replace the old instrument control systems. It is expected to be completed in 2006.

Dome Air Conditioning

The aim of the Dome Air Conditioning project has been to air condition the AAT Dome in order to sharpen the images obtainable at the telescope. This project is effectively complete and is currently keeping the telescope environment near the nightly temperature to improve the image quality delivered by the telescope. Records are being kept to track the effect on image quality.

SuperAAPS

The SuperAAPS project is an upgrade to the UCLES system to automate its operations in support of the long-term Anglo-Australian Planet Search observing program. The primary objectives are to:

- mount the iodine cell in the focal modifier wheel;
- mount a CCD camera behind the slit and feed with a 1% pick-off mirror to serve as an exposure meter;
- provide improved imaging functionality for acquisition of bright UCLES targets without human intervention; and
- integrate the above functionality with the new UCLES Instru ment Control System.

Starbugs

The starbugs project is a technology study that has been funded as part of the OPTICON program in Europe. Our effort is to look at the development of autonomous positioners that are able to configure themselves in the focal plane for multi-object spectroscopy with either fiber optics or relay optics. The study has recently completed the “Phase A” work package in which three prototype concepts were evaluated. Cryogenic performance was also attempted successfully.

Acknowledgements

MNRF: The MNRF program supporting Gemini provided additional funds that were required for the AAO to complete the WFMOS study.

Innovation Access Program: The research and development of Starbugs is proudly supported by the Innovation Access Program - International Science and Technology under the Australian Government innovation statement, Backing Australia’s Ability.

Human Resources

The AAO strives to provide challenging work combined with good employment conditions and work-life balance. The AAO is an equal employment opportunity employer and has a strong commitment to occupational health and safety.

Staff numbers

The AAO employs research scientists, technical staff, software engineers, electronics engineers, optical and mechanical engineers, administrative and library staff. Staff members are located at both the Epping Laboratory and at the Siding Spring Observatory. Table 4.4 shows staff numbers by tenure.

Table 4.4 Staff numbers by tenure

	Full-time FTE§	Part-time No.	Part-time FTE	Total FTE
FIXED TERM				
Director*	1	–	–	1
Research astronomers	5	–	–	5
Instrument scientists	–	–	–	–
Other fixed term	5	1	0.50	5.50
INDEFINITE				
Executive Officer*	1	–	–	1
Research astronomers	2	–	–	2
Instrument scientists	3	1	0.75	3.75
Other indefinite	45	2	1.40	46.40
Total staff	**62**	**4**	**2.65**	**64.65**

* *A direct Board appointment*
§ *Full Time Equivalent*

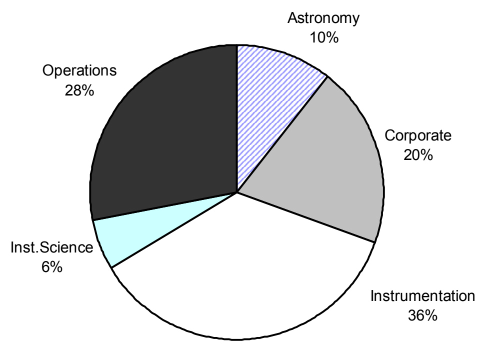
Staff by function

The functional areas of the AAO are:

- Astronomy, which includes staff astronomers, visiting astronomers, research fellows and visiting students.
- Operations, which is responsible for the running of the AAT and UKST at Siding Spring.
- Instrumentation, which builds instruments for the AAO telescopes and external clients.

- Instrument Science, which develops new technology.
- Corporate, which includes information technology, accounting, library and other support services.

Chart 4.15 shows staff by function



Employment arrangements

The AAO's terms and conditions of employment are set via a certified agreement, approved by the Australian Industrial Relations Commission, and the Anglo-Australian Telescope Board (Salaries and Conditions) Award 1999. The 2003-2005 agreement expired in April 2005 and was replaced by the Anglo-Australian Telescope Board Enterprise Agreement 2005-2007.

In accordance with the 2003 Agreement, negotiations on a new Agreement commenced within six months of the expiry of the Agreement. A Working Group consisting of staff elected delegates, the union (CPSU), and the Personnel and Executive Officers negotiated the new Agreement. The brief of the Working Group was to deliver to the Board an agreement that was well prepared, affordable, provided good outcomes for staff, and which had staff support. This was done and the staff vote was 98% in favour of the new agreement. The staff at the AAO are to be commended for their understanding of the AAO's financial position, the productivity gains made and their acceptance of the new Agreement.

In addition to developing a new agreement, the opportunity was taken to update some existing human resources policies as well as develop new ones.

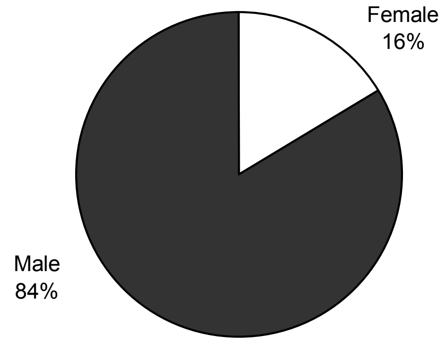


Chart 4.16 shows the relative numbers of male and female staff at the AAO

Equal Employment Opportunity (EEO)

The AATB is an equal employment opportunity employer and strongly supports workplace diversity. Chart 4.16 shows the ratio of males to females at the AAO and reflects the difficulty of attracting and retaining females in science.During the year the AAO also had 16 visiting students. Of this number 25% were female.

Occupational Health and Safety (OH&S)

The aim of the AAT Board's safety policy is to ensure that employees at every level and working visitors are provided with a safe and healthy working environment. The AAO has two Health and Safety committees – one at each site (Siding Spring and Epping) – which meet quarterly. They comprise staff and management representatives. The Executive Officer is a member of both committees. The names and contact details of committee members and the locations of first aid stations are posted on notice boards as are emergency evacuation details.

The OH&S plan for the year continued to raise awareness throughout the organisation with the specific focus for the year on emergency and evacuation policy and procedures.

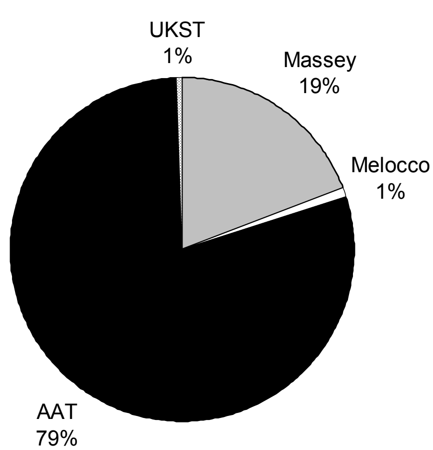
Comcare is a statutory authority responsible for workplace safety, rehabilitation and compensation in the Commonwealth of Australia's jurisdiction and is the AAT Board's Workers Compensation insurer. The AAO has worked hard to maintain a safe working environment. There have been no notifications of dangerous occurrences for the last five years.

Table 4.5 Workers' compensation and dangerous occurrences

	2000-01	2001-02	2002-03	2003-04	2004-05
No of claims	0	1	5	2	2
Payments made	0	$75	$12,400	$2,735	$3,241
Dangerous occurrences	0	0	0	0	0
Workers Compensation premiums	$23 751	$16 926	$15 612	$32 500	$37,309

During the year the AAT Board commissioned an external review of its OH&S infrastructure needs. The report identified various remedial works that need to be undertaken at both Epping and Siding Spring with the bulk of the work to be undertaken at the AAT (79% of all works by dollar value).

Chart 4.17 shows infrastructure upgrades by location



Following an approach by the AAT Board, the two Governments have agreed to provide in 2005/06 an amount of $2.7 million to meet identified OH&S infrastructure needs. Remedial works are expected to be completed over a 3 year timeframe commencing in late 2005. The AAO Safety Committees will be actively involved in the project.

Financial Resources

The financial statements in Appendix A outline the AAO's financial position. The Australian National Audit Office (ANAO) has audited the financial statements of the AATB and has provided a clear audit certificate. The auditor's report is also contained in Appendix A.

The AAO's sources of funds are:

- Government grants provided by Australia (DEST) and the United Kingdom (PPARC).
- Contracts for the building of instruments for external clients.
- Other revenue, including research grants, fellowships funded via the ARC and PPARC, and the RAVE international consortium for survey work on the UKST.

The AAT Board is funded mostly for recurrent expenditure and has to strike a balance between that expenditure, capital needs and tel-escope refurbishment. Funding from the Australian Government is made via the Department of Education Science and Training (DEST Output 3.1). This funding is indexed whilst that provided by the UK Government is not.

Chart 4.18 Sources of funds for 2004-05

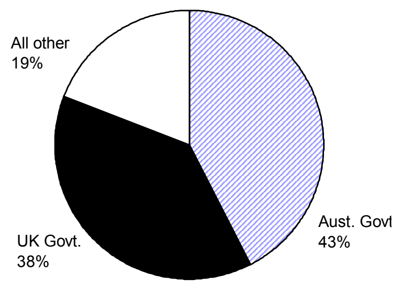
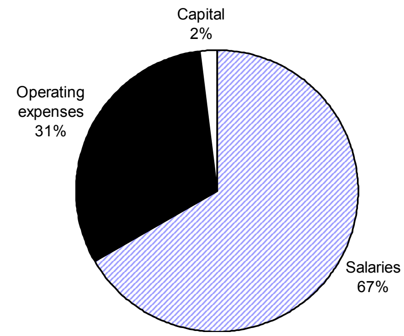


Chart 4.19 Application of funds for 2004-05



The financial focus of the AAT Board for the year has been on its short term budget position and identification of its longer term needs, especially in the context of the UK's gradual withdrawal over the next few years.

Performance during the year

The results for 2004-05 show that the AATB has net assets of $47.5 million; revenue increased by 2% over the previous year; expenses have decreased by 12% over the previous year; and a consequent reduced operating loss for the year. Operating losses in past years have been almost equal to the unfunded annual depreciation expense of the organisation. Estimated revenue for 2005–06 is $10.7 million and expenditure $10.5 million.

Information Technology

The development of a new IT Strategic Plan has been the major achievement this year. Key areas addressed are infrastructure management, security, communication between sites, replacement of legacy systems, the Telescope Control System and business interruption and disaster recovery. A lack of funds has inhibited capital investment in IT, but a new implementation plan should see the strategy realised over the next three years.

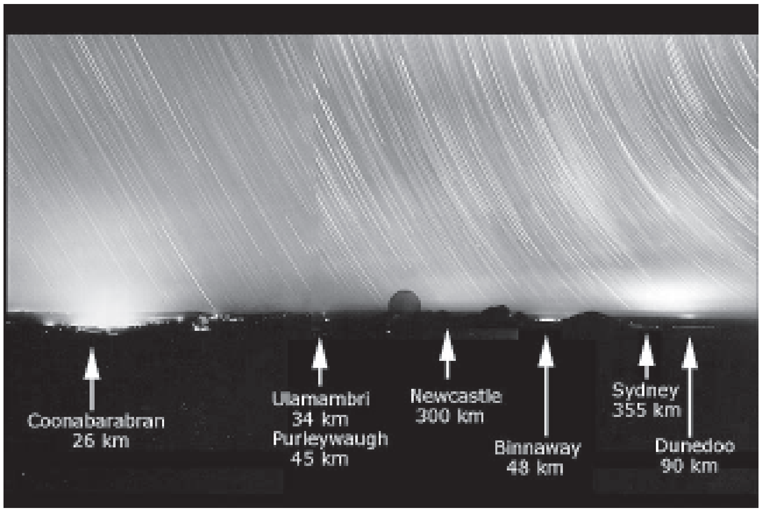
Environmental Performance

Dark-sky Protection

The AAO participates in activities designed to protect the dark sky of Siding Spring Observatory, and Dr Fred Watson (Astronomer in Charge) chairs an inter-organisational Working Group that develops and implements strategies to this end. While the principal activity of the group centres around lighting control legislation, another important function is to educate and inform the public about good and bad lighting, and the impact of light pollution on optical astronomy.

The Warrumbungle Shire Council (formerly Coonabarabran Shire) has adopted a Development Control Plan to limit upward light spill within its boundary. Work is also in progress on a new Orana Regional Environmental Plan (REP), which will address the issue of upward light spill in a large area of the state with a radius of 200 km centred on Siding Spring. The requirements for this have now been submitted to Parliamentary Counsel, as required by the appropriate planning protocols. The new REP attracted some media coverage during 2004–05 because of the four-fold increase in the area that the plan will cover, compared with the earlier version. The response to this sensitive issue has been generally positive.

Considerable work has been done during the year in establishing a technique for monitoring the Siding Spring horizon sky-glow. Invaluable help in this has come from Bob Shobbrook (formerly of Sydney University), and it is now possible to see (qualitively at least) the changes that have taken place since David Malin's well-known horizon images of the late 1980s (right). While there appears not to have been any significant overall degradation of the sky, the lights from several neighbouring centres have increased in prominence, most notably the cities of Dubbo and Tamworth.



Considerable work has been done in establishing a technique for monitoring the Siding Spring horizon sky-glow (photo: David Malin)

External Communications

The AAO is aware that good two-way communication is central to all its activities. While it must listen to its stakeholders, it must also communicate with the wider community. The stakeholders are the AAO staff, the astronomy community, responsible Ministers, funding agencies, the Board and its advisory committees and the time assignment panels. The community includes the general public, hence the broad term ‘Public Relations.’

World Wide Web and digital images

The AAO’s primary conduit for external communication, the website, has recently been upgraded. It continues to attract a large audience, with a consistent hit rate of over a million a month. These figures do not include the Cambridge (UK) mirror of the AAO site. Most of the Internet visitors are attracted by the images pages, which now support a total of about 220 photographs.

A newsletter is published three times a year on the web, and distributed as a hardcopy, to over 1,000 subscribers and institutions. It caters to a wide range of readers, including professional astronomers, instrument scientists, users of the observatory and local AAO staff.

The science web page has the aim of attracting students towards collaborative work at the AAO either through vacation positions or thesis study.

A wealth of more technical information is also available and is constantly being updated and developed.

Publicity and Outreach

This year the AAO issued media releases on five topics. The highest-profile of these was the announcement, in January 2005, of the detection of “baryonic wiggles” (see page 9 acoustic oscillations) in the data from the 2dF Galaxy Redshift Survey. The detection, and a complementary detection in data from the Sloan Digital Sky Survey, was announced simultaneously at press conferences in London and San Diego, California (at a meeting of the American Astronomical Society). It made front-page news in Australia.

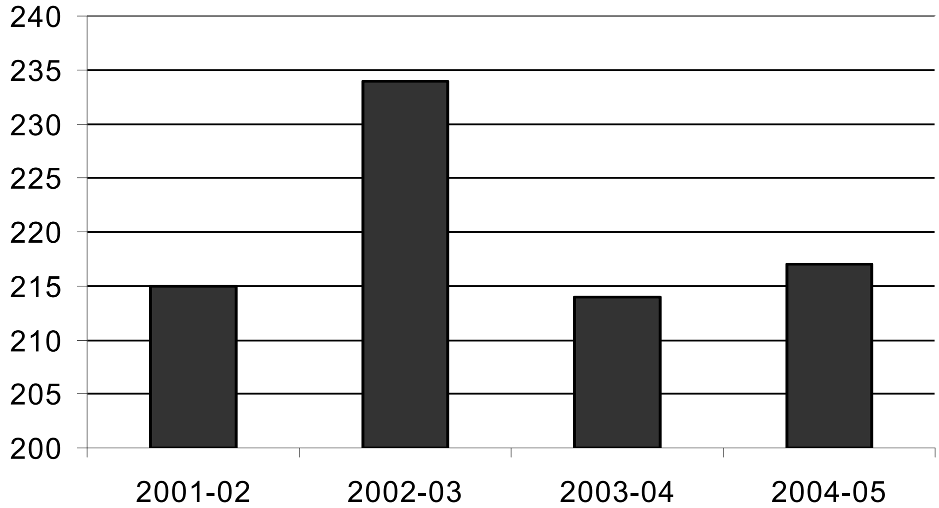
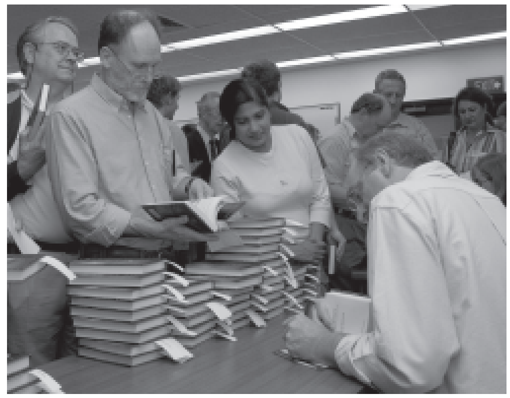


Figure 3.14 Media Interviews

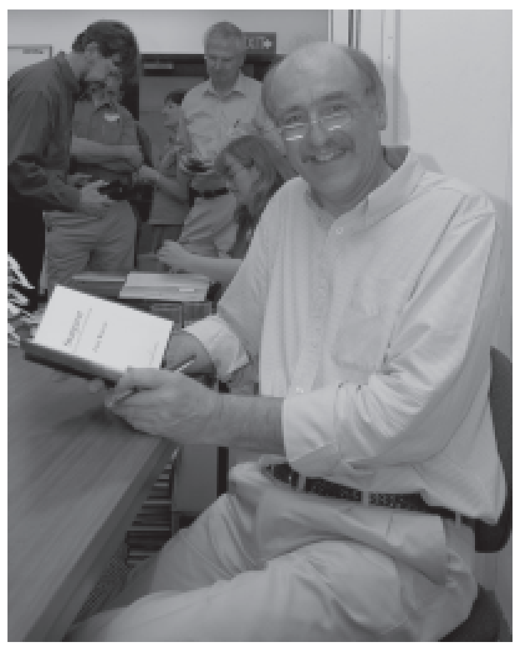
The Director, Matthew Colless pictured in a panel discussion with Simon Singh at the Sydney Writer's Festival, which attracted a full house, (photo: Australian Broadcasting Corporation)

During the 2004–05 year AAO staff gave 217 media interviews, 72 recorded talks to professional audiences, and a further 66 to audiences of lay–people. Many of the latter talks were given to amateur astronomy societies, but some reached wider audiences. In November 2004 AAO Director Matthew Colless gave, by invitation, the Malcolm McIntosh memorial lecture, established by CSIRO in memory of one of its former CEOs. The lecture was held at CSIRO's Black Mountain site in Canberra and attracted a capacity crowd. In June Dr Colless took part in a panel discussion on "Einstein's Big Bang" at the Sydney Writer's Festival (again to a full house); in June he participated in a similar event at the Mind, Body and Spirit Festival in Grafton, NSW. Both events were organised by the Australian Broadcasting Corporation as part of its 'Café Scientific' series, and were recorded for radio. Dr Colless was also the speaker for the 2004 Bok lecture, commemorating Bart Bok, which is one of the AAO's regular contributions to the annual Warrumbungle Festival of the Stars. In April 2005 the AAO's Fred Watson—billed as "Australia's answer to Patrick Moore"—gave the second Allison-Levick Memorial Lecture in Birmingham, UK, in association with the UK National Astronomy Meeting. The lecture, a public talk to be held at regular intervals , is funded by a bequest from Melbourne psychiatrist the late Mr Jack Allison-Levick to enhance the public understanding of astronomy and further the reputation of the AAO.

Fred Watson's long-awaited history of the optical telescope, *Stargazer*, was published in 2004. One of the book's many launches was held at the AAO's Sydney headquarters on 7 October, for more than sixty of Fred's friends and colleagues.



Pictured above some of the many attendees at the launch of Fred Watson's book "Stargazer". Below, Fred Watson (photos: Shaun Amy)



Appendix A
Financial Statements

Financial Statements

As provided for in the Anglo-Australian Telescope Agreement, the accounts, records and financial transactions of the Board are audited by the Australian Auditor-General. The form of the Board's financial statements for the year ended 30 June 2005 is in accord with orders made by the Finance Minister under the *Commonwealth Authorities and Companies Act 1997*.

Statement by the members of the Board

In our opinion, the attached financial statements for the year ended 30 June 2005 are based on properly maintained financial records and give a true and fair view of the matters required by the Finance Minister's Orders made under the *Commonwealth Authorities and Companies Act 1997*.

In our opinion, at the date of this statement, there are reasonable grounds to believe that the Anglo-Australian Telescope Board will be able to pay its debts as and when they become due and payable.

This statement is made in accordance with a resolution of the Board.

Pat Roche.

Chair of the Board
October 2005

Deputy Chair of the Board
October 2005

Australian National
Audit Office

INDEPENDENT AUDIT REPORT

To the Minister for Education, Science and Training

Matters relating to the Electronic Presentation of the Audited Financial Statements

This audit report relates to the financial statements published in both the annual report and on the website of Anglo-Australian Telescope Board (the Board) for the year ended 30 June 2005. The directors of the Board are responsible for the integrity of both the annual report and the web site.

The audit report refers only to the financial statements, schedules and notes named below. It does not provide an opinion on any other information which may have been hyperlinked to/from the audited financial statements.

If the users of this report are concerned with the inherent risks arising from electronic data communications they are advised to refer to the hard copy of the audited financial statements in the Board's annual report.

Scope

The financial report and Directors' responsibility

The financial report comprises:

- Directors' Declaration;
- Statements of Financial Performance, Financial Position and Cash Flows; and
- Notes to and forming part of the Financial Report

of the Anglo-Australian Telescope Board for the year ended 30 June 2005.

The Directors of the Board are responsible for preparing a financial report that gives a true and fair view of the financial position and performance of the Board, that comply with Finance Minister's Orders made under the *Commonwealth Authorities and Companies Act 1997,* accounting standards and other mandatory financial reporting requirements in Australia. The Board are also responsible for the maintenance of adequate accounting records and internal controls that are designed to prevent and detect fraud and error, and for the accounting policies and accounting estimates inherent in the financial statements.

Audit approach

I have conducted an independent audit of the financial statements in order to express an opinion on them to you. My audit has been conducted in accordance with the Australian National Audit Office Auditing Standards, which incorporate the Australian Auditing and Assurance Standards, in order to provide reasonable assurance as to whether the financial statements are free of material misstatement. The nature of an audit is influenced by factors such as the use of professional judgement, selective testing, the inherent limitations of internal control, and the availability of persuasive, rather than conclusive, evidence. Therefore, an audit cannot guarantee that all material misstatements have been detected.

PO Box A456 Sydney South NSW 1235
130 Elizabeth Street
SYDNEY NSW
Phone (02) 9367 7100 Fax (02) 9367 7102

While the effectiveness of management's internal controls over financial reporting was considered when determining the nature and extent of audit procedures, the audit was not designed to provide assurance on internal controls.

I have performed procedures to assess whether, in all material respects, the financial statements present fairly, in accordance with Finance Minister's Orders made under the *Commonwealth Authorities and Companies Act 1997*, accounting standards and other mandatory financial reporting requirements in Australia, a view which is consistent with my understanding of the Board's financial position, and of its performance as represented by the statements of financial performance and cash flows.

The audit opinion is formed on the basis of these procedures, which included:

- examining, on a test basis, information to provide evidence supporting the amounts and disclosures in the financial statements; and
- assessing the appropriateness of the accounting policies and disclosures used, and the reasonableness of significant accounting estimates made by the Directors.

Independence

In conducting the audit, I have followed the independence requirements of the Australian National Audit Office, which incorporate the ethical requirements of the Australian accounting profession.

Audit Opinion

In accordance with subsection 19(1) of the *Anglo-Australian Telescope Agreement Act 1970,* I now report that the financial report is in agreement with the accounts and records of the Anglo-Australian Telescope Board, and in my opinion:

(i) the financial report is based on proper accounts and records;

(i) the financial report gives a true and fair view, in accordance with the Finance Minister's Orders, applicable Accounting Standards and other mandatory professional reporting requirements in Australia, of the financial position of the Anglo-Australian Telescope Board as at 30 June 2005, and its financial performance and cash flows for the year then ended;

(ii) the receipt, expenditure and investment of moneys, and the acquisition and disposal of assets, by the Board during the year have been in accordance with the *Anglo-Australian Telescope Agreement Act 1970*; and

(iii) the financial statements have been prepared in accordance with Finance Minister's Orders made under the *Commonwealth Authorities and Companies Act 1997*.

Australian National Audit Office

P Hinchey
Senior Director
Delegate of the Auditor-General

Sydney
21 October 2005

ANGLO-AUSTRALIAN TELESCOPE BOARD
STATEMENT OF FINANCIAL PERFORMANCE
for the year ended 30 June 2005

	Notes	**2005 $'000**	2004 $'000
REVENUE			
Revenues from ordinary activities			
Australian government	1.3	**4,112**	4,032
United Kingdom government	1.3	**3,700**	3,700
Goods and services	4A	**1,462**	1,403
Bank interest		**53**	47
Other revenues	4B	**358**	268
Revenues from ordinary activities		**9,685**	9,450
EXPENSE			
Expenses from ordinary activities			
Employees	5A	**5,414**	5,740
Suppliers	5B	**2,156**	2,669
Depreciation and amortisation	5C	**2,767**	2,626
Write-down of assets		**-**	686
Net foreign exchange (loss)/gain		**3**	(2)
Expenses from ordinary activities		**10,340**	11,719
Net operating result surplus (deficit)		**(655)**	(2,269)
Net (debit) credit to asset revaluation reserve	10	**4,328**	-
Total revenues, expenses and valuation adjustments recognised directly in equity.		**-**	-
Total changes in equity other than those resulting from transactions with owners as owners		**3,673**	(2,269)

ANGLO-AUSTRALIAN TELESCOPE BOARD
STATEMENT OF FINANCIAL POSITION
for the year ended 30 June 2005

	Notes	2005 $'000	2004 $'000
ASSETS			
Financial assets			
Cash	6A	**356**	996
Receivables	6B	**277**	1,163
Total financial assets		**633**	2,159
Non-financial assets			
Land and buildings	7A, 7C	**23,608**	22,240
Infrastructure, plant and equipment	7B, 7C	**25,984**	23,480
Other non-financial assets	7D	**65**	116
Total non-financial assets		**49,657**	45,836
Total assets		**50,290**	47,995
LIABILITIES			
Provisions			
Employees	8A	**1,790**	2,019
Total Provisions		**1,790**	2,019
Payables			
Suppliers	9A	**37**	73
Other	9B	**998**	2,111
Total Payables		**1,035**	2,184
Total liabilities		**2,825**	4,203
NET ASSETS		**47,465**	43,792
EQUITY			
Reserves	10	**40,303**	35,975
Retained surpluses	10	**7,162**	7,817
TOTAL EQUITY		**47,465**	43,792
Current liabilities		**1,741**	3,100
Non-current liabilities		**1,084**	1,103
Current assets		**698**	2,275
Non-current assets		**49,592**	45,720

ANGLO-AUSTRALIAN TELESCOPE BOARD
STATEMENT OF CASH FLOWS
for the year ended 30 June 2005

	Notes	2005 $'000	2004 $'000
Operating Activities			
Cash received			
Goods and services		**2,354**	1,222
Revenue from Australian Government		**3,084**	4,032
Contributions from UK Government		**3,700**	4,625
Interest		**53**	47
GST recovered from ATO		**292**	226
Other		**322**	268
Total cash received		**9,805**	10,420
Cash used			
Employees		**(5,644)**	(5,405)
Suppliers		**(2,490)**	(3,042)
Total cash used		**(8,134)**	(8,447)
Net cash from operating activities	11	**1,671**	1,973
Investing Activities			
Cash used			
Purchase of property, plant and equipment		**(2,311)**	(1,596)
Total cash used		**(2,311)**	(1,596)
Net cash from(used by) investing activities		**(2,311)**	(1,596)
Net increase/(decrease) in cash held		**(640)**	377
Cash at the beginning of the reporting period		**996**	619
Cash at the end of the reporting period	6A	**356**	996

ANGLO-AUSTRALIAN TELESCOPE BOARD
SCHEDULE OF COMMITMENTS
for the year ended 30 June 2005

	2005 $'000	2004 $'000
By Type		
Capital commitments	**-**	-
Other Commitments		
Operating Leases[1]	**79**	57
Total Commitments	**79**	57
Commitments Receivable	**(7)**	(5)
Net commitments	**72**	52
By Maturity		
Other commitments		
One year or less	**67**	48
From one to two years	**12**	9
Commitments receivable		
One year or less	**(6)**	(4)
From one to two years	**(1)**	(1)
Net Commitments	**72**	52

[1]Operating leases exist in relation to motor vehicles, are non-cancellable and for fixed terms of two or three years.

SCHEDULE OF CONTINGENCIES
as at 30 June 2005

	2005 $'000	2004 $'000
Contingent liabilities and assets	**-**	-

ANGLO-AUSTRALIAN TELESCOPE BOARD
NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS
for the year ended 30 June 2005

Note 1. Summary of Significant Accounting Policies

1.1 Basis of Accounting

The financial statements are required by subsection 19(1) of the *Anglo-Australian Telescope Agreement Act 1970* and are a general purpose financial report.

The statements have been prepared in accordance with:

- Finance Minister's Orders (being the *Commonwealth Authorities and Companies Orders (Financial Statements for reporting periods ending on or after 30 June 2005));*
- Australian Accounting Standards and Accounting Interpretations issued by the Australian Accounting Standards Board; and
- Urgent Issues Group Abstracts

The Statements of Financial Performance and Financial Position have been prepared on an accrual basis and are in accordance with the historical cost convention except for certain assets which, as noted, are at valuation. Except where stated, no allowance is made for the effect of changing prices on the results or on the financial position.

Assets and liabilities are recognised in the Statement of Financial Position when it is probable that future economic benefits will flow and the amounts of the assets or liabilities can be reliably measured. Assets and liabilities arising under agreements equally proportionately unperformed are, however, not recognised unless required by an accounting standard. Liabilities and assets that are unrecognised are reported in the Schedule of Commitments and the Schedule of Contingencies.

Revenues and expenses are recognised in the Statement of Financial Performance when the flow or consumption or loss of economic benefits has occurred and can be reliably measured.

1.2 Changes in Accounting Policy

The accounting policies used in the preparation of these financial statements are consistent with those used in 2003-04.

Revaluations at 30 June 2005 were done on a fair value basis. Revaluations up to 30 June 2002 were done on a 'deprival' basis and since that date, have been done on a fair value basis. Revaluation increments and decrements in each year of transition to fair value that would otherwise have been accounted for as revenue or expenses have been taken directly to accumulated results in accordance with transitional provisions of AASB 1041 *Revaluation of Non-Current Assets*.

1.3 Revenue

The AAT Board recognises revenue applying to a financial period according to the source of the funds and the nature of any agreement that may be in place with the funding body. The Governments of Australia and the United Kingdom provide most of the Board's revenue and their contributions are recognised at the time the Board receives the revenue and any funds received prior to the due date are treated as a creditor while funds outstanding after the due date are treated as a debtor. Australian revenue is via a parliamentary appropriation to the Department of Education, Science and Technology (DEST). United Kingdom (UK) funds are via its Particle Physics and Astronomy Research Council (PPARC).

The Board also builds astronomical instrumentation for other observatories and attempts to recover the full economic cost of so doing. Revenue is recognised at the time of invoice which is set by the achievement of agreed milestones. Associated costs are accrued or deferred as a prepayment to match revenues reported within the financial period.

Grants are received from the Australian Research Council (ARC) and PPARC for the specific purpose of employing astronomers at the Observatory. Grants are recognised as revenue on receipt.

Resources Received Free of Charge

Services received free of charge are recognised as revenues when and only when a fair value can be reliably determined and the services would have been purchased if they had not been donated. Use of those resources is recognised as an expense.

Contributions of assets at no cost of acquisition or for nominal consideration are recognised at their fair value when the asset qualifies for recognition.

The following resources are received free of charge*:*

(i) Use of Land

At Siding Spring Observatory in north western New South Wales, the 3.9 metre Anglo-Australian Telescope (AAT) building and the 1.2 metre UK Schmidt Telescope (UKST) building are on land owned by the Australian National University (ANU).

At Epping, New South Wales, the Board’s buildings are on a site of the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The Board has entered into a permissive occupancy agreement with CSIRO covering its establishment at Epping. A rental of 10 cents a year is payable on demand and the term of this agreement is until the AAT Agreement ceases, or if terminated by agreement of the parties - whichever is earlier.

(ii) Use of the UK Schmidt Telescope

The UK Schmidt Telescope is owned by PPARC and operated by the Board. The UK Government through its agencies has also entered into a permissive occupancy agreement with the ANU for its establishment at Siding Spring at a rental of one dollar per year if and when demanded. The term of the lease is for not less than forty years from 1 July 1971.

1.4 Employee Benefits

(a) Benefits

Liabilities for services rendered by employees are recognised at the reporting date to the extent that they have not been settled.

Liabilities for wages and salaries (including non-monetary benefits) and annual leave are measured at their nominal amounts. Other employee benefits expected to be settled within 12 months of their reporting date are also measured at their nominal amounts.

The nominal amount is calculated with regard to the rates expected to be paid on settlement of the liability.

All other employee benefit liabilities are measured as the present value of the estimated future cash outflows to be made in respect of services provided by employees up to the reporting date.

(b) Leave

The liability for employee benefits includes provision for annual leave and long service leave. No provision has been made for sick leave as all sick leave is non-vesting and the average sick leave taken in future years by employees of the Board is estimated to be less than the annual entitlement for sick leave.

The leave liabilities are calculated on the basis of employees' remuneration, including the Board's superannuation contribution rates to the extent that the leave is likely to be taken during service rather than paid out on termination.

The non-current portion of the liability for long service leave is recognised and measured at the present value of the estimated future cash flows to be made in respect of all employees at 30 June 2005. In determining the present value of the liability, the Board has taken into account attrition rates and pay increases through promotion and inflation.

(c) Superannuation

Employees are members of the Commonwealth Superannuation Scheme and the Public Sector Superannuation Scheme. The liability for their superannuation benefits is recognised in the financial statements of the Commonwealth and is settled by the Commonwealth in due course.

The Anglo-Australian Telescope Board makes employer contributions to the Commonwealth at rates determined by the Commonwealth's actuary to be sufficient to meet the cost to the Commonwealth of the superannuation entitlements of the Board's employees.

1.5 Leases

A distinction is made between finance leases and operating leases. Finance leases effectively transfer from the lessors to the lessee substantially all the risk and benefits incidental to ownership of leased assets. In operating leases, the lessor effectively retains all such risks and benefits. The Board has no finance leases.

Operating lease payments are expensed on a basis which is representative of the pattern of benefits derived from the leased assets.

1.6 Cash

Cash means notes and coins held and any deposits held at call with a bank or financial institution.

1.7 Insurance

The Board's workers' compensation cover is provided through Comcare Australia. On the basis that the Board is not fully controlled by the Commonwealth of Australia, the Department of Finance and Administration decided that the Board will not be eligible to belong to Comcover after 30 June 2004. Consequently, the Board has all its other insurance cover with commercial providers.

1.8 Acquisition of Assets

Assets are recorded at cost on acquisition except as stated below. The cost of acquisition includes fair value of assets transferred in exchange and liabilities undertaken.

1.9 Property (Land, Buildings and Infrastructure), Plant and Equipment

Asset Recognition Threshold

Purchases of property, plant and equipment are recognised at cost in the Statement of Financial Position. Individual items with a purchase value of less than $3,000 are not considered material and are included in the Statement of Financial Performance as Supplier expenses.

Revaluations

(i) Basis

Land, buildings, infrastructure, plant and equipment are carried at valuation. Revaluations undertaken up to 30 June 2002 were done on a deprival basis; revaluations since that date are at fair value. This change in accounting policy is required by Australian Accounting Standard AASB 1041 *Revaluations of Non-Current Assets.*

Fair values for each class of asset are determined as shown below:

Asset class	***Fair value measured by:***
Land	Market selling price
Epping buildings	Market selling price
Domes	Depreciated replacement cost
Telescope and ancillary equipment	Depreciated replacement cost
Telescope instrumentation	Depreciated replacement cost
Plant and equipment	Market selling price

Under fair value, assets that are surplus to requirements are measured at their net realisable value. At 30 June 2005, the Board held no surplus assets. (30 June 2004: $0)

The financial effect of this change in policy relates to those assets recognised at fair value for the first time in the current period where the measurement basis for fair value is different to that previously used for deprival value. The financial effect of the change is given by the difference between the fair values obtained for these assets in the current period and the deprival-based values recognised at the end of the previous period. The financial effect of the 2004-05 revaluation exercise was a credit $4,328,000 to the asset revaluation reserve. (30 June 2004: $0)

(ii) Frequency

The Finance Minister's Orders require that all property, plant and equipment assets be measured at up-to-date fair values from 30 June 2005 onwards. The current year is therefore the last year in which the Anglo-Australian Telescope Board will undertake progressive revaluations.

(iii) *Conduct*

Valuations of land, buildings and plant and equipment are conducted by an independent qualified valuer. Valuations of telescopes and instrumentation are conducted in-house.

(iv) Depreciation

Depreciable property, plant and equipment assets are written down to their estimated residual values over their estimated useful lives to the Board using, in all cases, the straight line method of depreciation.

Depreciation rates (useful lives) and methods are reviewed at each balance date and necessary adjustments are recognised in the current, or current and future reporting periods, as appropriate. Residual values are re-estimated for a change in prices only when assets are revalued.

Useful lives applying to each class of depreciable assets are as follows:

Asset class	***2005***	***2004***
Buildings	**50 years**	50 years
Telescope and Ancillary Equipment	**50 years**	50 years
Telescope Instrumentation	**20 years**	20 years
Personal Computers	**3 years**	3 years
Other Computers	**5 years**	5 years
Other Plant and Equipment	**20 years**	20 years

The aggregate amount of depreciation allocated for each class of asset during the reporting period is disclosed in Note 5C.

1.10 Taxation

The Board is exempt from taxation except for the GST and FBT. Employees are liable for FBT on salary packaging.

1.11 Foreign Currency

The contributions from the United Kingdom are converted to Australian dollars at the selling rate quoted by the Bank of England at the time each contribution is made. All other transactions denominated in a foreign currency are converted at the exchange rate at the date of the transaction. Foreign currency receivables and payables are translated at the exchange rates current as at balance date. Associated currency gains and losses are not material.

1.12 Agreements

Under an agreement between the Board and the PPARC, the Board is responsible for the management, care and maintenance, operation and development of the UK Schmidt Telescope (UKST). The revenues, expenses and asset values in respect of the UKST form part of the financial statements. See also note 1.3 relating to use of land.

1.13 External Projects

The Board builds telescope instrumentation for other Australian and international telescope bodies. These contracts are either on a time and materials basis or a fixed price basis. The projects are costed to result in break-even results on completion. In the event of a surplus or over-run arising, it is the policy of the Board to absorb these.

2. Adoption of Australian Equivalents to International Financial Reporting Standards from 2005-2006

2.1 Overview

The Australian Accounting Standards Board has issued replacement Australian Accounting Standards to apply from 2005-06. The new standards are the Australian Equivalents to International Financial Reporting Standards (IFRS). The new standards cannot be adopted early.

The Australian Equivalents contain certain additional provisions which will apply to not-for-profit entities, including the Anglo-Australian Telescope Board. Some of these provisions are in conflict with the IFRS and therefore the Anglo-Australian Telescope Board will be able to assert compliance only with the Australian Equivalents to the IFRS.

Existing AASB standards that have no IFRS equivalent will continue to apply.

2.2 Management of the transition to Australian Equivalents to IFRS

The Anglo-Australian Telescope Board has taken the following steps in preparation towards the implementation of Australian Equivalents:

- Appointing the Executive Officer to oversight the transition to and implementation of the Australian Equivalents to IFRS.
- Identification of all major accounting policy differences between current AASB standards and the Australian Equivalents to IFRS progressively to 30 June 2004.
- Identification of systems changes necessary to be able to report under the Australian Equivalents, including those necessary to capture data under both sets of rules for 2004-05, and the testing and implementation of those changes.
- Preparation of a transitional balance sheet as at 1 July 2004, under Australian Equivalents.
- Preparation of an Australian Equivalent balance sheet as at 30 June 2005.

2.3 Major changes in accounting policy under Australian Equivalents

Changes in accounting policies under Australian Equivalents are applied retrospectively i.e. as if the new policy had always applied. This rule means that a balance sheet prepared under the Australian Equivalents must be made as at 1 July 2004, except as permitted in particular circumstances by AASB 1 *First-time Adoption of Australian Equivalents to International Financial Reporting Standards*. The 2005-06 financial statements will thus show comparatives under the Australian Equivalents.

Property plant and equipment

It is expected that the Finance Minister's Orders will require property plant and equipment assets to be measured at up-to-date fair value from 2005-06. This differs from the accounting policies in place for these assets which, up to and including 2004-05, have been revalued progressively over a 3-year cycle and which include assets at cost (for purchases since the commencement of a cycle) and at deprival value. Where a market selling price is not available, their fair value has been measured at depreciated replacement cost.

Note 3. Economic Dependency

The Board was established by the Anglo-Australian Telescope Agreement Act 1970 and depends heavily on the revenue provided by the Governments of Australia and the United Kingdom. The United Kingdom Government has indicated its intention to withdraw from the Agreement with effect from 1 July 2010. This notice period allows for an orderly withdrawal by the UK Government and sufficient time for the Australian Government to plan for the future of the AAO.

Arrangements to give effect to this and related matters have been prepared in the form of a 'Supplementary Agreement'. During 2005-06, it is expected that:

- the two Governments will sign the Supplementary Agreement,
- legislation to amend the AAT Agreement Act will be introduced to the Australian Parliament - no such legislative approval is required by the UK Government, and
- once the legislation has been approved by the Parliament, the treaty amendment will take effect with an exchange of diplomatic notes between the two Governments.

The gradual withdrawal of the UK funding does provide the Board with some challenges. The Board intends maintaining operations at the AAT at their current level. The shortfall will be recovered through increased levels of external revenue obtained by the Board's instrumentation program, based at its Sydney headquarters and through access to the UK funding agency's competitive grants program.

	2005	2004
Note 4. Operating revenues	**$'000**	$'000
4A Sales of Goods and services		
Goods - external entities	**855**	1,210
Services - external entities	**607**	193
Total sales of goods and services	**1,462**	1,403
Cost of sales of goods	**665**	831
4B Other Revenues		
Grants and fellowships	**287**	196
All other	**73**	72
Total	**358**	268
Note 5. Operating Expenses		
5A Employees		
Wages and salaries	**4,117**	4,400
Superannuation	**810**	786
Leave and other benefits	**421**	501
Other employee expenses	**30**	39
Total employee benefits expenses	**5,378**	5,726
Workers' compensation premiums	**36**	14
Total employee expenses	**5,414**	5,740
5B Suppliers		
Goods from external entities	**326**	624
Services from external entities	**1,425**	1,706
Motor vehicle lease costs	**102**	96
Supply of goods and services: external projects	**303**	243
Total suppliers' expenses	**2,156**	2,669

ANGLO-AUSTRALIAN TELESCOPE BOARD
NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS
for the year ended 30 June 2005

5C Depreciation and amortisation

	2005	2004
	$'000	$'000
Property, plant and equipment	**2,767**	2,626

The aggregate amounts of depreciation allocated during the reporting period, either as expense or as part of the carrying amount of other assets, for each class of depreciable asset, are as follows:

Buildings	**1,017**	1,006
Telescopes	**789**	706
Instruments	**666**	596
Plant and equipment	**295**	318
Total depreciation	**2,767**	2,626

Note 6 Financial assets

6A Cash

Cash at bank and on hand (Note 17A)	**356**	996

6B Receivables

Goods and services	**181**	-
Other receivables	**18**	1,097
GST Receivable	**78**	66
Total receivables net (Note 17A)	**277**	1,163

Receivables for Goods and Services

Credit terms are net 30 days (2004: 30 days)

Receivables (gross) are aged as follows:		
Not Overdue	**227**	1,121
Overdue by:		
-Less than 30 days	**-**	31
-30-60 days	**-**	-
-more than 60 days	**50**	11
Total receivables (gross)	**277**	1,163

Note 7: Non-Financial assets

7A Land and buildings

	2005	2004
	$'000	$'000
Land at 1 July 2002 valuation (fair value)	**-**	2,368
Land at 30 June 2005 valuation (fair value)	**2,968**	-
Total land	**2,968**	2,368
Buildings at 1 July 2002 valuation (fair value)	**-**	50,250
Buildings at 30 June 2005 valuation (fair value)	**55,965**	-
Less accumulated depreciation	**(35,325)**	(30,459)
	20,640	19,791
Buildings at cost	**-**	82
Less accumulated depreciation	**-**	1
	-	81
Total buildings	**20,640**	19,872
Total land and buildings	**23,608**	22,240

	2005 $'000	2004 $'000
7B Infrastructure, plant and equipment		
Telescope & ancillary equipment at 1 July 2004 valuation (deprival)	**-**	35,137
Telescope & ancillary equipment at 1 July 2004 valuation (fair value)	**39,457**	-
Less accumulated depreciation	**(24,605)**	(21,207)
	14,852	13,930
Telescope and ancillary equipment at cost	**-**	26
Less accumulated depreciation	**-**	(4)
	-	22
Telescope instrumentation at 1July 2004 valuation (deprival)	-	11,236
Telescope instrumentation at 1 July 2004 valuation (fair value)	**18,360**	-
Less accumulated depreciation	**(8,665)**	(6,876)
	9,695	4,360
Telescope instrumentation at cost	**-**	3,632
Less accumulated depreciation	**-**	(73)
	-	3,559
Other plant and equipment at 1 July 2004 valuation (deprival)	**-**	2,220
Other plant and equipment at 1 July 2004 valuation (fair value)	**3,645**	-
Less accumulated depreciation	**(2,209)**	(1,357)
	1,436	863
Other plant and equipment at cost	**-**	1,322
Less accumulated depreciation	**-**	(576)
	-	746
Total Infrastructure, plant and equipment	**25,984**	23,480

All revaluations are conducted in accordance with the revaluation policy stated in note 1.9.

7C. Analysis of Property, Plant and Equipment

TABLE A

Reconcilliation of opening and closing balances of property, plant and equipment

Item	Land '000	Buildings $'000	Total land and buildings $'000	Plant and equipment $'000	Total $'000
Gross value as at 1 July 2004	**2,368**	**50,332**	**52,700**	**53,573**	**106,273**
- Additions-purchase of assets	-	87	87	2,224	2,311
- Revaluations	600	5,546	6,146	5,665	11,811
Gross value as at 30 June 2005	**2,968**	**55,965**	**58,933**	**61,462**	**120,395**
Accumulated depreciation as at 1 July 2004	-	30,460	30,460	30,093	60,553
- Depreciation charge for year	-	1,017	1,017	1,750	2,767
- Revaluation	-	3,848	3,848	3,635	7,483
Accumulated depreciation as at 30 June 2005	**-**	**35,325**	**35,325**	**35,478**	**70,803**
Net book value as at 30 June 2005	**2,968**	**20,640**	**23,608**	**25,984**	**49,592**
Net book value as at 1 July 2004	2,368	19,872	22,240	23,480	45,720

TABLE B

Assets at valuation

Item	Land $'000	Buildings $'000	Telescope $'000	Instruments $'000	Plant & equipment $'000	Total $'000
As at 30 June 2005						
Gross value	**2,968**	**55,965**	**39,457**	**18,360**	**3,645**	**120,395**
Accumulated depreciation	**-**	**35,325**	**24,605**	**8,665**	**2,208**	**70,803**
Net book value	**2,968**	**20,640**	**14,852**	**9,695**	**1,437**	**49,592**
As at 30 June 2004						
Gross value	2,368	50,250	35,137	11,236	2,220	101,211
Accumulated depreciation	-	30,459	21,207	6,876	1,357	59,899
Net book value	2,368	19,791	13,930	4,360	863	41,312

ANGLO-AUSTRALIAN TELESCOPE BOARD
NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS
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	2005	2004
	$'000	$'000
7D Other non-financial assets		
Prepayments for goods and services - includes insurance premiums, rentals in advance and subscriptions; all pre-payments are current	**65**	116

Note 8. Provisions

8A Employees		
Salaries and wages	**25**	209
Leave	**1,765**	1,529
Superannuation	**-**	281
Aggregate employee benefits liability and related costs	**1,790**	2,019
Current	**706**	915
Non-current	**1,084**	1,103
	1,790	2,019

Note 9. Payables

9A Suppliers		
Trade creditors	**37**	73
All suppliers' payables are current		

9B Other		
Non Trade creditors	**-**	1,081
PPARC Contribution in Advance	**925**	925
National Astronomical Observatory of Japan (note 16A)	**74**	94
University of Durham UK (note 16B)	**-**	12
Total Other Payables	**998**	2,111
All Other payables are current		

Note 10. Analysis of Equity

	Accumulated Result		Revaluation Reserve		Total Equity	
	2005	2004	**2005**	2004	**2005**	2004
	$'000	$'000	**$'000**	$'000	**$'000**	$'000
Opening balance at 1 July	**7,817**	10,086	**35,975**	35,975	43,792	46,061
Net surplus (deficit)	**(655)**	(2,269)			(655)	(2,269)
Net revaluation increment/(decrement)	**-**	-	**4,328**	-	**4,328**	-
Closing balance at 30 June	**7,162**	7,817	**40,303**	35,975	**47,465**	43,792

Note 11. Cash Flow Reconciliation

Reconciliation of net deficit to net cash from operating activities:	2005 $'000	2004 $'000
Operating result surplus (deficit)	**(655)**	(2,269)
Non-Cash Items		
Depreciation/amortisation	**2,767**	2,626
Property, plant, equipment write off	**0**	686
Changes in assets and liabilities:		
Decrease/(increase) in receivables	**886**	(859)
Increase/decrease in prepayments	**51**	(36)
Increase/(decrease) in employee provisions	**(15)**	335
Increase/(decrease) in supplier payables	**(36)**	(65)
Increase/(decrease) in other payables	**(1,327)**	1,555
Net cash from operating activities	**1,671**	1,973

Note 12. Related Party Disclosures and Remuneration of Directors

Members of the Board at 30 June 2005 were:

UK - Dr P Roche (Chair), Dr M Irwin and Mr G Brooks,
Australia - Professor W Couch (Deputy Chair), Dr B Schmidt and Mr G Harper

Board members do not receive remuneration.

During the year, the terms of the following Board members expired:

Professor R D Ekers (Chair), Australia Telescope National Facility (1 July 1997 – 31 December 2004)
Professor M Birkinshaw (Deputy Chair), University of Bristol (31 December 2003 – 1 January 2005)

Dr Brian Schmidt is also an employee of the ANU Research School of Astronomy and Astrophysics. The AAT is on land owned by the ANU which also provides site services to the AAO at Siding Spring. (See also note 1.3).

Professor R D Ekers is an Australian Research Council Federation Fellow, hosted by Australia Telescope National Facility, a Division of CSIRO. The AAO buildings at Epping are on land owned by the CSIRO. (See also note 1.3).

Note 13. Remuneration of Officers

The numbers of officers who received or were due to receive total remuneration of $100,000 or more are as follows:

	2005 Number	2004 Number
$100 000 - $109 999	**1**	-
$120 000 - $129 999	**1**	1
$130 000 - $139 999	**2**	3
$140 000 - $149 999	**2**	2
$150 000 - $159 999	**1**	-
$180 000 - $189 999	**1**	-
Total	**8**	6
	$	$
Aggregate amount of total remuneration of officers shown above	**1,126,728**	**813,256**

Note 14. Remuneration of Auditors

	2005 $	2004 $
Remuneration to the Auditor-General for auditing the financial statements for the reporting period, excluding GST	**28,000**	26,500

Services were also provided by the Auditor-General during the year in connection with validating MNRF and OPTICON FP6 expenditure.

Note 15. Average Staffing Levels

	2005	2004
The average staffing (headcount) levels for the year were:	**66**	68

Note 16. External Projects

16A The National Astronomical Observatory of Japan contracted the AAT Board to design and build a fibre positioner, Echidna, for the Subaru Telescope. The contract began just before the end of the 1998-99 year and will be completed in 2006. The position at 30 June 2005 was as follows:

	2005 **$'000**	2004 $'000
Instalments received	**638**	800
Suppliers' expenses	**(218)**	(345)
Employee expenses	**(267)**	(514)
Balance from prior year	**95**	488
On cost credited to other revenue	**(174)**	(334)
Instalments unexpended- included in Other Liabilities	**74**	95

16B Astrophotonics

This project commenced April 2004 following a successful joint application by the Board and Durham University to PPARC for funding. The project aims to investigate and report on the application of photonic technology to astronomical instrumentation. Durham University is the primary grant-holder and disburses the PPARC funds to the Board as the project progresses.

	2005 **$'000**	2004 $'000
Instalments received	**61**	23
Deferred instalments	**12**	0
Subtotal	**73**	23
Suppliers' expenses	**(11)**	0
Employee expenses	**(42)**	(11)
Overhead Recovered	**(20)**	0
Project Profit(Loss) absorbed by AAO	**0**	0
Instalments deferred (Other Liabilities)	**0**	12
Instalment Receivable (Debtors)	**0**	0

Note 17. Financial Instruments.

Terms, conditions and accounting policies

Financial Instrument	Notes	Accounting Policies and Methods (including recognition criteria and measurement basis)	Nature of underlying instrument (including significant terms and conditions affecting the amount, timing and certainty of cash flows)
Financial Assets	6	Financial assets are recognised when control over future economic benefits is established and the amount of the benefit can be reliably measured.	
Cash at Bank	6A	Cash at Bank is recognised at the nominal amount. Interest is credited to revenue as it accrues.	
Receivables for goods and services	6B	These receivables are recognised at the nominal amounts due less any provision for bad and doubtful debts. Provisions are made when collection of the debt is judged to be less rather than more likely.	Receivables are with both Commonwealth and external entities. Credit terms are net 30 days (2003/04: 30 days)
Financial liabilities	9	Financial liabilities are recognised when a present obligation to another party is entered into and the amount of the liability can be reliably measured.	
Trade creditors	9A 9B	Creditors and accruals are recognised at their nominal amounts, being the amounts at which the liabilities will be settled. Liabilities are recognised to the extent that the goods and services have been received (irrespective of having been invoiced).	Settlement is usually made net 30 days (2003/04: 30 days).
		Amounts owing to Creditors representing unspent contributions, are recognised at their nominal amount.	Funds will be expended in the ending 30 June 2006.

Note 17A. Interest rate risk

Financial Instrument	Note	Floating Interest Rate 2005 $'000	Floating Interest Rate 2004 $'000	Non Interest Bearing 2005 $'000	Non Interest Bearing 2004 $'000	Total 2005 $'000	Total 2004 $'000
Financial Assets							
Cash at Bank	6A	**330**	963	**-**	-	**330**	963
Cash on Hand	6A	**-**	-	**26**	33	**26**	33
Receivables	6B	**-**	-	**277**	1,163	**277**	1,163
Total Financial Assets		**330**	963	**303**	1,196	**633**	2,159
Total Assets						**50,290**	47,995
Financial Liabilities							
Suppliers	9A	**-**	-	**37**	73	**37**	73
Other	9B	**-**	-	**998**	2,111	**998**	2,111
Total Financial Liabilities		**-**	**-**	1,035	**2,184**	1,035	2,184
Total Liabilities						**2,825**	4,203

The weighted average effective interest rate for Cash at Bank is 4.73% p.a. (2003-04 3.96% p.a.)

Financial Assets: The net fair value of cash assets is their carrying value as shown.

Financial Liabilities: The net fair values of suppliers and other payables, all of which are shortterm in nature, are their carrying values as shown.

Note 17B. Credit Risk Exposures

The Anglo-Australian Telescope Board's maximum exposure to credit risk at reporting date in relation to each class of recognised financial assets is the carrying amount of those assets as indicated in the Statement of Financial Position. The Board has no significant exposures to any concentration of credit risk.

Appendix B
Staff

Staff at 30 June 2005

Director:	M M Colless, PhD, FAA
Executive Officer & AAT Board Secretary:	N Legg, BA (Ec) MBA, FAIM
Head of Astronomy:	C G Tinney, PhD
Head of Instrumentation:	S C Barden, PhD
Head of Instrument Science:	J Bland-Hawthorn, PhD
Operations Manager:	C J McCowage
Astronomer-in-Charge:	F G Watson, PhD
Head of Information Technology:	C Ramage, MEngSc
Astronomy & Instrument Science:	S M Croom, PhD; S C Ellis, PhD; R Haynes, PhD; A J McGrath, PhD; Q A Parker, PhD; S D Ryder, PhD; W Saunders, PhD; R Sharp, PhD;
Project Management:	C J Evans, MIEAust CPEng; G Frost, BE MBA;
Administration:	D Hewawitharana; D R Kingston, CPA; R L Martin, K Powell, BA; G C Simms; H M Woods, MLitt;
Library:	S D Ricketts, BSc
Software Development:	T J Farrell, BSc; R Heald, BSc; P Innes, BA; K Shortridge, PhD; S Smedley, B App Sc; M Vuong, BE, B App Sc
Information Technology:	H Davies, MEngSc: R G Dean; G J Kitley; K M Tapia-Sealey, PhD;
Electronics Group:	J A Collins; D B Correll, BE; S M James; D J Mayfield; R Muller; M Oestreich, BE; R G Patterson; E J Penny; J H Stevenson; L G Waller, BE
Optical and Mechanical:	J K Brzeski, BE; V Churilov, MSc; J P Dawson, BE; D Horiuchi; M M Kanonczuk; U Klauser; A F Lankshear, BSc; S Miziarski, DipME; N A Schirmer; G A Smith, BE BSc; D J Stafford; J D Whittard
Telescope Operations & Maintenance:	UKST: D M Burton; C J P Cass; M Hartley, BSc; K S Russell AAT: W C Clarke; K Fiegert; B Jones; S Lee; J Pogson;
Public Relations:	H Sim, MSciSoc
AAO Associates:	J A Bailey, PhD; R D Cannon PhD; P R Gillingham, BE DSc D F Malin, DSc; W Orchiston, PhD

Anglo-Australian Observatory

Organisation Chart - 30 June 2005

EPPING STAFF

COONABARABRAN STAFF

ANGLO-AUSTRALIAN TELESCOPE BOARD

BOARD SECRETARY
(Neville Legg)

DIRECTOR
Matthew Colless

PUBLIC RELATIONS
Helen Sim

PERSONAL ASSISTANT
Helen Woods

ASTRONOMY
Chris Tinney
Scott Croom*
Stuart Ryder*
Quentin Parker*
(AAO/Macquarie Lecturer)
Fellows & Visitors
Rob Sharp
(2dF Fellow)
Simon Ellis
(AAO Research Fellow)
Greg Madsen
NSF/MPS Post Doc Fellow/JBH
Students *
Lachlan Campbell
(ANU Phd thesis, Jan 06)
Craig Harrison
(Mt Stromlo - till Jul 05)
Stephen Fine
Phd Student from Sydney Uni/S.Croom
Warren Reid
PhD student/MAC, Aug 06
Berian James
Honors Student U.Syd
AAO Vacation Students:
Sam Illingworth
Pablo Mur
Khee Gan Lee

INSTRUMENTATION
Sam Barden

SOFTWARE
Tony Farrell
Keith Shortridge
Ronald Heald
Minh Vuong
Scott Smedley
Peter Innes*

MECHANICAL/ OPTICAL
John Dawson
Reuben Barnes*
Jurek Brzeski
Vladimir Churilov
Stan Miziarski
Greg Smith
Urs Klauser
Denis Whittard
Dwight Horiuchi
Neal Schirmer

COMPUTERS/ ELECTRONICS
Lew Waller
David Correll
Don Mayfield
Rolf Muller
Ed Penny

PROJECT OFFICE
Chris Evans*
Gabriella Frost

INSTRUMENT SCIENCE
Joss Hawthorn
Roger Haynes
Andrew McGrath
Will Saunders
Students *
Jackie Marcel
PhD Student/Sydney Uni till July 07

EXECUTIVE OFFICER
Neville Legg
ADMINISTRATION
Devika Hewa
Don Kingston
Kathleen Powell
Greta Simms
LIBRARY
Sandra Ricketts

INFORMATION TECHNOLOGY
Chris Ramage
Bob Dean
Garry Kitley
Katrina Tapia-Sealey
Helen Davies

OPERATIONS
Chris McCowage

ADMINISTRATION
Rhonda Martin

MECHANICAL WORKSHOP
Brendan Jones
Mick Kanonczuk
Wayne Clarke

MECHANICAL DESIGN
Allan Lankshear*

ELECTRONICS
Martin Oestreich
Shaun James
John Collins
Robert Patterson
Darren Stafford
John Stevenson
Kristin Fiegert

INSTRUMENT SUPPORT
Steve Lee

BUILDING SERVICES
Jonathan Pogson

ASTRONOMER IN CHARGE
Fred Watson*
OBSERVERS
Paul Cass
Donna Burton*
(Kristin Fiegert)*
Malcolm Hartley
Ken Russell
ASSISTANTS
(Shaun James)
(Steve Lee)
(Jonathan Pogson)
(John Stevenson)

Notes:
1. Staff with an asterisk * are fixed term
2. Names in parentheses appear elsewhere in the chart.
3. Staff on right side are based at Siding Spring, Coonabarabran while those on the left at Epping.

Appendix C
Client Service Charter

ABOUT US

Who We Are

The Anglo-Australian Observatory consists of the 3.9-metre Anglo-Australian Telescope (AAT) and the 1.2-metre UK Schmidt Telescope (UKST) on Siding Spring Mountain, outside Coonabarabran, NSW, and a headquarters facility and instrumentation laboratory in the Sydney suburb of Epping.

Our Purpose

The main purpose of the Anglo-Australian Observatory is to provide world-class optical and infrared observing facilities enabling Australian and UK astronomers to do excellent science.

Our Clients

Our clients are the astronomers who are awarded (through competitive processes) observing time on Anglo-Australian Observatory telescopes.

ABOUT THIS CHARTER

This Charter sets out our commitments towards the service we will provide to you. It also sets out what you can do to make sure you get the best possible outcome from your observing run.

The Observatory is committed to maintaining and improving the quality of its services. We will monitor our performance in meeting the commitments set out in this Charter and change it as necessary. Your suggestions for improvement would be valued.

The AAO will report on its performance in its Annual Report.

IF YOU HAVE A COMPLAINT

If you have a problem or a complaint, please let the Director know of your concerns and, if possible, how you think improvements might be made. You can phone on +61 2 9372 4812, fax on +61 2 9372 4880 or email director@aao.gov.au.

WHAT YOU CAN EXPECT FROM US

Courtesy

- We will be helpful and courteous in our dealings with you

Telescope Operations

- The AAT and UKST will be fully operational at the start of each night.
- A technician will be on duty during the first part of the night to respond immediately to any technical problems.
- At other times there will be a two-hour response time by the afternoon shift technician.
- An AAT night assistant will be on duty all night and will operate the telescope. If there are any problems during the night, the night assistant will take immediate action either to fix the problem or arrange for someone else to fix it.

Instrumentation

- An AAO support astronomer will get in touch with you to confirm the details of your observing run at least four weeks prior to the run.
- We will provide the instrumentation at the start of the night that will enable you to undertake your scientific program as specified.
- If requested, a support astronomer will be present for the first night of your run to help you obtain the best possible data.
- We will make available full documentation to guide you in carrying out your observations.

Data Exploitation

- We will provide adequate computer hardware and software to allow you to store, access and analyse all data acquired with AAO instrumentation during your observing run.

General Working Environment

- We will provide office space and facilities for each visiting observer.
- We will provide a comfortable and functional control room.
- We will provide a library with essential astronomical and technical journals and texts.

Administration

- We will respond by the next working day to your inquiries.
- We will make your bookings for you at the Siding Spring Observatory Lodge.
- We will assist you with arranging transport between Sydney and Coonabarabran.

What we would like you to do

- Arrive properly prepared for your observing run.
- Make yourself familiar with the safety guidelines and follow them at all times.
- Be thoughtful and considerate in the demands you make of AAO staff.
- Make sure your data is recorded on a suitable backup medium at the end of your observing run.
- Give us constructive feedback on how we may improve our service, using the observer report form.
- If we do particularly well, let us know.

Appendix D
Statement on governance

1. The Anglo-Australian Telescope Board

The AAT Board oversees the operations of the AAO.

A. Functions, capacities and powers

The functions, capacities and powers of the AAT Board are contained in Section 8 of the Anglo-Australian Telescope Agreement Act 1970:

The Board has the functions specified in Article 8 of the Agreement, and the capacities and powers specified in paragraph (1) of Article 6 of the Agreement, and shall perform those functions, and exercise those capacities and powers, in accordance with the Agreement.

The Board has such additional functions as are conferred on it by the regulations.

The Board has power to do all things necessary or convenient to be done in connection with the performance of its additional functions.

Article 6

(1) The Telescope Board to be incorporated under an enactment of the Parliament of the Commonwealth of Australia shall be a body corporate with perpetual succession and a Common Seal and shall have such capacities and powers as are necessary and incidental to the performance of its functions under this Agreement including, without affecting the generality of the foregoing capacities and powers:

(a) to acquire, hold and dispose of real and personal property;

(b) to enter into contracts including contracts for the performance of works and contracts of service and for services;

(c) to employ persons;

(d) to sue and be sued;

(e) to receive gifts;

(f) to do anything incidental to any of its powers.

Article 8

(1) The functions of the Telescope Board shall be to do or arrange or cause to be done, subject to and in accordance with Article 2 of this Agreement, such acts, things and matters as shall provide for or contribute to the manufacture, construction, operation and management of the telescope.

B. Membership

The AAT Board has six members, three appointed by each country, and the role of Chair and Deputy Chair alternate between the two countries. At 30 June 2005 the Board members and their terms of office were:

United Kingdom

Dr P Roche, Reader, Department of Astrophysics, Oxford University; appointed 1 January 2003 till 31 December 2006

Dr M Irwin, Director, Cambridge Astronomical Survey Unit, Institute of Astronomy, University of Cambridge; appointed 1 January 2005 till 31 December 2007

Mr G Brooks, Head of Astronomy Division, Particle Physics and Astronomy Research Council (Indefinite appointment).

Australia

Professor W Couch, Head, School of Physics University of New South Wales appointed 5 November 2004 till 4 November 2006

Dr B Schmidt, ARC Professorial Fellow, Research School of Astronomy and Astrophysics, Australian National University; appointed 1 January 2005 till 31 December 2006

Mr G Harper, Deputy CEO, Australian Research Council, Canberra appointed 5 November 2004 till 4 November 2006.

During the year, the terms of the following Board members expired:

Professor R D Ekers, (Chair), Federation Fellow, Australia Telescope National Facility (1 July 1997 – 31 December 2004)

Professor M Birkinshaw, (Deputy Chair), William P Coldrick Professor of Cosmology and Astrophysics, University of Bristol (31 December 2003 – 1 January 2005)

C. Board meeting attendance

The AAT Board met four times this year although only three of the meetings were formal Board meetings.

Board member	No. of meetings attended
Dr P Roche, (Chair)	4/4
Professor W Couch (Deputy Chair)	4/4
Dr Schmidt	4/4
Mr Harper	4/4
Mr G Brooks	4/4
Dr Irwin	3/4
Professor R D Ekers (Former Chair)	2/2
Professor M Birkinshaw (Former Deputy Chair)	2/2

D. Special responsibilities

Messrs Harper and Brooks have been nominated by the Designated Agencies, DEST and PPARC respectively, to represent their agencies on all matters in relation to the operation of the Agreement.

2. Audit and Risk Managment Committee

At its April 2005 meeting, the Board established an Audit and Risk Management Committee with the following objectives:

- Enhancing the management and internal control framework necessary to manage the AAO's business.
- Ensuring the AAO has appropriate risk identification and management practices in place.
- Improving the objectivity and quality of significant financial information.
- Assisting the Board to comply with all legislative and other obligations.

The Audit and Risk Management Committee currently comprises two non-executive Board members, Messrs Brooks and Harper, and Mr John M. Williams B.Ec, FCPA from the CSIRO, as the third independent member of the Committee.

Notwithstanding the recent formation of the above committee, the AAO is proactive in risk management. For example, a detailed risk analysis of the AAT computer control system was completed during the year in accordance with the Australia/New Zealand risk management standard AS/NZS 4360:1999. In addition, any new project proposal has to be accompanied by a detailed risk assessment.

3. Performance Management

The AAO has an active performance management system. During the year, the Performance Management Policy was revised to provide more options for recognizing good performance and for dealing with poor performance. Divisional and individual work plans are prepared annually with a view to providing clarity for staff in their work, identifying training needs, and to provide performance measures to track actual progress. Every attempt is made to ensure that these plans are consistent with the Corporate Plan. The annual staff appraisals take place in March/April each year.

4. Ethical standards

All staff are required to observe the AAO Code of Conduct.

Appendix E
Advisory Committees

Time allocation committees

Under Article 5 of the Anglo-Australian Telescope Agreement, observing time and use of associated facilities and services is shared equally by Australia and the UK. The Board has chosen to exercise its responsibility for the allocation of time on the AAT and UKST through arrangements made with the two Designated Agencies. Under guidelines set by the Board, each agency operates through national committees – the Australian Time Assignment Committee (ATAC) and the UK Panel for the Allocation of Telescope Time (PATT) – which allocate time on the AAT on the basis of the scientific merit of proposals submitted by astronomers, including AAO staff.

At 30 June 2005, membership of the committees was:

ATAC

Dr M Drinkwater (Qld) *Chair*

Dr M Asplund (RSAA) *Deputy Chair*

Dr M Burton (NSW)

Dr G Lewis (Sydney)

Dr S Driver (RSAA)

Dr R Webster (Melbourne)

Dr P Tuthill (Sydney)

PATT

Dr B Best (Edin) *Chair*

Dr S Ryan (OU)

Dr J van Loon (Keele)

Dr P Outram (Durham)

The AAO Users' Committee

The AAO Users' Committee (AAOUC) consists of six members: three external members each from the UK and Australia.

Its terms of reference are:

1. To provide advice to the Director on operational and developmental issues relating to the facilities provided by the AAO. These include the Anglo-Australian Telescope, the UK Schmidt Telescope and all aspects of support provided by the AAO.

2. To make recommendations to the Director that seek to maximise the scientific productivity and maintain the competitiveness of the Observatory, taking into account the likely resources availability.

3. To consult widely with the community, liaising where necessary with national time assignment groups, to establish priorities for both operational and instrumentation initiatives.

4. To interface with the design review panels, commenting on any issues arising from these panels that impact on the delivery of key user science requirements.

5. To provide a written report through the Director for submission to each September meeting of the AAT Board.

At 30 June 2005 the six AAOUC members were:

Australia	United Kingdom
Dr Brad Gibson (Swinburne)	Dr Ian Parry (IoA) (Chair)
Dr Peter Wood (RSAA)	Dr Alastair Edge (Durham)
Dr Baerbel Koribalski (ATNF)	Dr Sean Ryan (OU)

Glossary

Abbreviations & Acronyms

AAO	Anglo-Australian Observatory
AAOmega	An optical spectrograph under development for the AAT
AAPS	Anglo-Australian Planet Search
Aarhus	Aarhus University, Denmark
AAOUC	AAO Users' Committee
AAT	Anglo-Australian Telescope
ADFA	Australian Defence Force Academy
AGB Star	Asymptotic giant branch star
AMNH	American Museum of Natural History
ANU	Australian National University
ARC	Australian Research Council
Arizona	University of Arizona, USA
Armagh	Armagh Observatory, UK
ASA	Astronomical Society of Australia
ATAC	Australian Time Assignment Committee
ATNF	Australia Telescope National Facility
AURA	Association of Universities for Research in Astronomy
Berkeley	University of California, Berkeley, USA
Birm	University of Birmingham, UK
Bristol	University of Bristol, UK
Caltech	California Institute of Technology, USA
Cardiff	University of Wales, College of Cardiff, UK
Carnegie	Carnegie Institution of Washington, USA
CCD	Charge coupled device
CERN	European Laboratory for Particle Physics, Switzerland
CMB	Cosmic microwave background
CSIRO	Commonwealth Scientific and Industrial Research Organisation, Australia
DAZLE	Infrared narrowband imager destined for the VLT in 2005
DEST	Department of Education, Science & Training (Australia)
Diffraction grating	A surface on which are ruled very fine and evenly spaced straight grooves which break light into a spectrum by diffraction

Durham	University of Durham, UK
Echidna	A fibre positioner being built for National Astronomical Observatory of Japan by the AAO
Edin	University of Edinburgh, UK
EEV	English electric valve CCD
Erlangen	Friedrich-Alexander University Erlangen-Nuremberg, Germany
ESA	European Space Agency, Germany
ESO	European Southern Observatory, Garching, Germany
FBG	Fibre Bragg Grating
FLAMES	Fibre Large Array Multi Element Spectrograph
FMOS	Faint multi-object spectrometer destined for the Subaru telescope in 2005
FTE	Full time equivalent
Gemini	Gemini Telescopes Project
GMOS	GMOS: Gemini Multi-Object Spectrograph
Grating	see diffraction grating
Grism	A combined diffraction grating and prism used in spectroscopy
GSFC	NASA Goddard Space Flight Center, USA
Hawaii	University of Hawaii, USA
HSCA	Harvard-Smithsonian Center for Astrophysics, USA
HST	Hubble Space Telescope
Herts	University of Hertfordshire, UK
IAC	Instituto de Astrofísica de Canarias
IAP	Institut d'Astrophysique de Paris, France
ICI	Instrument Control and Integration
IfA	Institute for Astronomy, Edinburgh, UK
IFU	Integral field unit
ING	Isaac Newton Group, La Palma, Spain
IoA	Institute of Astronomy, University of Cambridge, UK
IPAC	Infrared Processing and Analysis Center
IR	Infrared
IRIS2	Infrared imager/spectrograph
JHU	Johns Hopkins University, USA
JILA	Joint Institute for Laboratory Astrophysics, Colorado, USA
JPL	Jet Propulsion Laboratory, USA
KAOS	Kilo-Aperture Optical Spectrograph
Keele	Keele University, Staffordshire, UK
KPNO	Kitt Peak National Observatory, Arizona, USA
LAS	Laboratoire d'Astronomie Spatiale, Marseille, France
LDSS	Low dispersion survey spectrograph
Leeds	University of Leeds, UK
Leicester	University of Leicester, UK

Lick	Lick Observatory, USA
Liv JM	Liverpool John Moores University, UK
LLNL	Lawrence Livermore National Laboratory, California, USA
LMC	Large Magellanic Cloud
Los Alamos	Los Alamos National Laboratory, USA
Melbourne	University of Melbourne
MIT	Massachusetts Institute of Technology, USA
MITLL3	Massachusetts Institute of Technology, Lincoln Laboratories, deep depletion CCD
MMF	Multimode fibre
MOS	Multi Object Spectrograph
MOMFOS	Multi-object Multi-Fibre Optical Spectrograph
MPIA	Max-Planck-Institut für Astronomie, Germany
MRAO	Mullard Radio Astronomy Observatory, UK
Mullard	Mullard Space Science Laboratory, UK
NAOJ	National Astronomical Observatory of Japan
NASA	National Aeronautics and Space Administration
NC	University of North Carolina, USA
NRAO	National Radio Astronomy Observatory, USA
NOAO	National Optical Astronomy Observatory, USA
ODC	Optical Detector Controllers
OGLE	Optical Gravitational Lensing Experiment
OH	Oxygen+Hydrogen diatomic molecule
OMP	Observatoire Midi-Pyrenées, France
Open U	Open University, London, UK
Oxford	University of Oxford, UK
OzPoz	A fibre positioner for the VLT
Palomar	Palomar Observatory, USA
Paris	Observatoire de Paris, France
PATT	Panel for the Allocation of Telescope Time, UK
Photonics	The science of how light can be manipulated within materials
PNe	Planetary nebulae
PPARC	Particle Physics & Astronomy Research Council, UK
Qld	University of Queensland
QSO	Quasi-stellar object
QUK	Queen’s University, Kingston, Canada
RAL	Rutherford Appleton Laboratory, UK
RAVE	RAdial Velocity Experiment
REP	Orana Regional Environmental Plan No 1
RGO	Royal Greenwich Observatory, UK
ROE	Royal Observatory, Edinburgh, UK
RSAA	Research School for Astronomy and Astrophysics, Australian National University
SDSS	Sloan Digital Sky Survey
Sheffield	University of Sheffield, UK
6dF	Six Degree Field facility for the UKST
6dFGS	Six Degree Field Galaxy Survey

SHS	SuperCOSMOS H-alpha Survey
SMC	Small Magellanic Cloud
SMF	Single mode fibre
Southampton	University of Southampton, UK
SPIE	Society of Photo-Optical Instrumentation Engineers
SPIRAL	An IFU using fibres to feed a dedicated spectrograph
St Andrews	University of St Andrews, Scotland, UK
Stanford	Stanford University, USA
Starbug	A positioning technology using micro-robotic actuators
Steward	Steward Observatory, University of Arizona, USA
STScI	Space Telescope Science Institute, USA
Subaru	An optical infrared telescope owned by the National Astronomical Observatory of Japan, based in Hawaii
Sussex	University of Sussex, UK
SWRI	Southwest Research Institute, Texas, USA
Swinburne	Swinburne University of Technology
Sydney	University of Sydney
TAC	Time assignment committee
Taurus	Fabry-Perot imaging spectrograph
TCS	Telescope Control System
Tokyo	University of Tokyo, Japan
Toronto	University of Toronto, Canada
TTF	Taurus tunable filter
2dF	Two Degree Field facility for the AAT
UCL	University College London, UK
UCLA	University of California, Los Angeles, USA
UCLES	University College London Echelle Spectrograph
UHRF	Ultra high resolution facility (with UCLES)
UKATC	UK Astronomy Technology Centre, Edinburgh, UK
UKST	UK Schmidt Telescope
UNSW	University of NSW
UNSWIRF	University of NSW Infrared Fabry-Perot
USQ	University of Southern Queensland
UVES	Ultraviolet and Visual Echelle Spectrograph
Victoria	University of Victoria, Canada
VIMOS	VIsible MultiObject Spectrograph
VLT	Very Large Telescope
VPH	Volume phase holographic (grating)
WATEC	Digital camera
WFI	Wide field imager
WFMOS	Wide-field multi object spectrograph
WN stars	Wolf-Rayet star of type N (nitrogen)
WO stars	Wolf-Rayet star of type O (oxygen)

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