Anglo-Australian Observatory

Annual Report
of the Anglo-Australian
Telescope Board

1 July 2005 to 30 June 2006

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Anglo-Australian Telescope Board

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The Honourable Julie Bishop, MP
Minister for Education, Science and Training
Government of the Commonwealth of Australia

The Right Honourable Alistair Darling, 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 2005 to 30 June 2006. 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

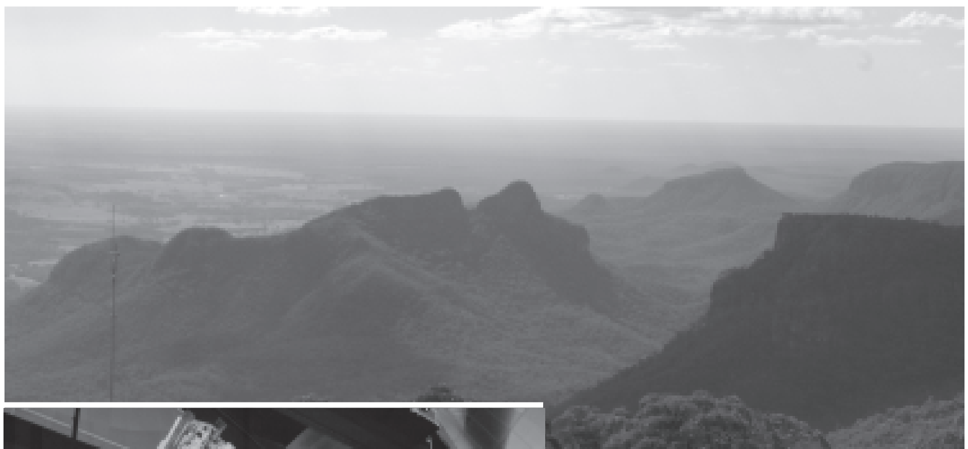
The Anglo-Australian Observatory (AAO) provides world-class optical and infrared observing facilities enabling Australian and British astronomers to do excellent science. The AAO is a world leader in astronomical research and in the development of innovative telescope instrumentation. It also takes a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

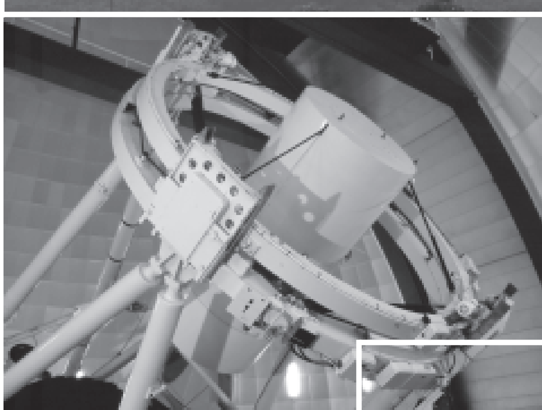
History and governing legislation

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, realised this goal. The Act established the Anglo-Australian Telescope Board (AATB) as the independent bi-national entity that owns and operates the telescope, with funding provided by the Governments of Australia and the United Kingdom.

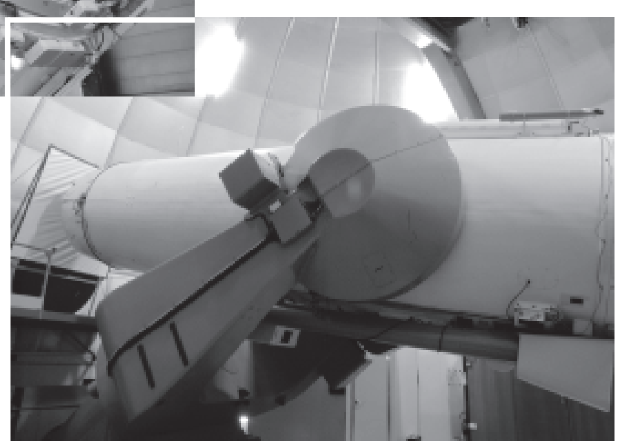
The 3.9-metre Anglo-Australian Telescope (AAT) was opened in 1974 on Siding Spring Mountain near Coonabarabran in north-west NSW. In 1988, the operation of another telescope on the same site, the 1.2-metre UK Schmidt Telescope (UKST), was transferred to the AAT Board. These two telescopes, together with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

The United Kingdom government indicated its intention to withdraw from the AAT 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 were encapsulated in the form of a ‘Supplementary Agreement’ signed by the two Governments and followed by legislative and diplomatic processes. The Anglo-Australian Telescope Agreement Amendment Act 2006 was passed early in 2006 and the treaty amendment is now in effect.





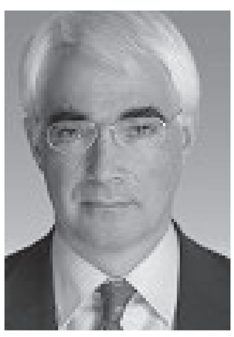
Top: View over Warrumbungle National Park from Siding Spring. Photo Jonathan Pogson. Left, Top end of the Anglo-Australian Telescope, Below, UK Schmidt Telescope. Photos Shaun Amy



The AAO laboratory, Epping. Photo Urs Klauser

Ministers responsible for the AAT Board

The Minister responsible in the United Kingdom is The Right Hon. Alistair Darling MP, Secretary of State for Trade and Industry.



The Minister responsible in Australia is The Hon. Julie Bishop 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 day-to-day operations of the two 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, Professor 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. Prof. Colless is a Fellow of the Australian Academy of Science. In 2005 he became Adjunct Professor at the School of Physics, University of Sydney.

Audit and Risk Management Committee

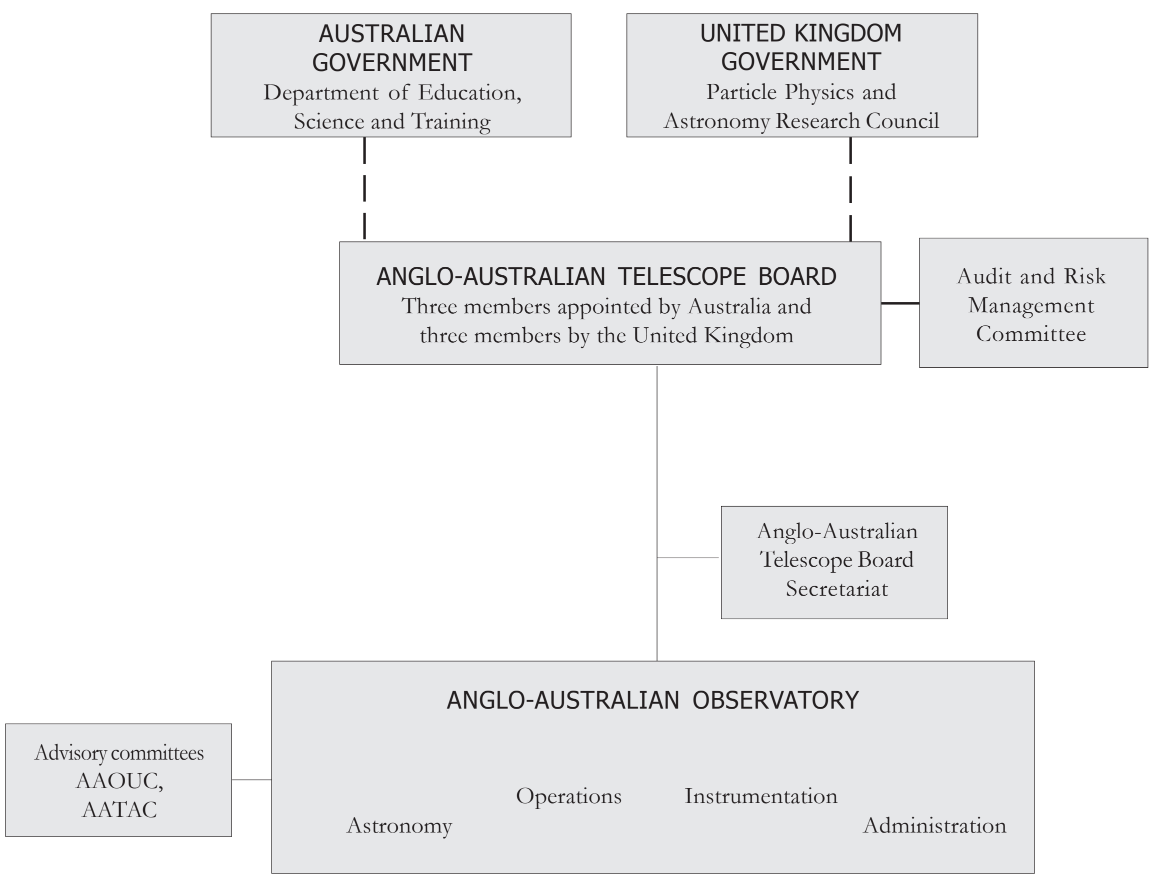
The AAT Board established the Audit and Risk Management Committee to improve its corporate governance. Details of the Committee are included in Appendix D.

Advisory committees

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

Prior to November 2005, observing time on the AAT was allocated by two national committees: the Australian Time Assignment Committee (ATAC) and the UK Panel for the Allocation of Telescope Time (PATT). Subsequently, observing time on the AAT is now allocated by a single bi-national panel, the Anglo-Australian Time Allocation Committee, details of which are included in Appendix E.

Figure 1.1 General structure of the AAO



2. The year in review

Review by the Director

Professor Matthew Colless, FAA
Director of the AAO

Overview

A new era for the AAO was initiated by the signing of the *Supplementary Agreement* by Australia and the UK and the passing of the *Anglo-Australian Telescope Agreement Amendment Act 2006*. The new Agreement paves the way for the gradual withdrawal of the UK from the Observatory, with the AAT and all other assets expected to revert to sole Australian ownership from 1 July 2010.

This evolution of the underpinnings of the AAO has both immediate and far-reaching effects. In 2005–06, the impact was felt through the amalgamation of the separate Australian and British telescope time allocation committees in a single joint committee: the Anglo–Australian Time Allocation Committee (AATAC). However in future the effect will be more dramatic, with the UK reducing its funding for the AAO by 50% in 2006–07, and halving its contribution again in 2007–08; UK funding then remains constant until the end of the Agreement in

2009–10. The reduced level of UK funding will be reflected in a reduced UK share of time on the AAT. Australian share will conversely increase, but the AAO would have significantly fewer resources for operating the AAT and its other facilities.

The Australian Government has moved quickly in response to this situation, with the Minister for Education, Science and Training commissioning a review of the AAO by an independent panel of experts early in 2006. The report[1] of the review panel was submitted to the Minister on 30 June 2006, and makes recommendations to the AAT Board on preparing for the transition to Australian ownership in 2010, and recommendations to the Minister regarding the continuation of the AAO after 2010 and the funding required by the AAO under the new Agreement and beyond. The Minister's response to the report is expected soon, and will determine both the short and long-term actions of the Observatory.

The Australian astronomical community's vision for the AAO's future is contained in *New Horizons: A Decadal Plan for Australian Astronomy 2006–2015*[2]. The Decadal Plan was launched in November 2005 after a year-long process of consultation and discussion within the astronomical community. The Plan envisages the AAO evolving over the decade to become the national optical observatory (the "Australian Astronomical Observatory") – a counterpart to the national radio observatory role played by the CSIRO's Australia Telescope National Facility.

The Decadal Plan recommends that the AAO should continue to operate the AAT as Australia's largest on-shore optical telescope at least until 2015. As the national optical observatory, the AAO would also be responsible for managing and supporting Australia's involvement in international facilities, such as its current 6.2% share in the twin 8-metre telescopes of the Gemini Observatory, as well as possible future shares in one of the proposed new generation of 20 and 30-metre telescopes (such as the Giant Magellan Telescope) or an Antarctic telescope (such as the proposed 2.4-metre PILOT telescope). The AAO therefore has a long-term mission, extending beyond the expected lifetime of the AAT, to provide essential infrastructure support for Australian optical astronomy.

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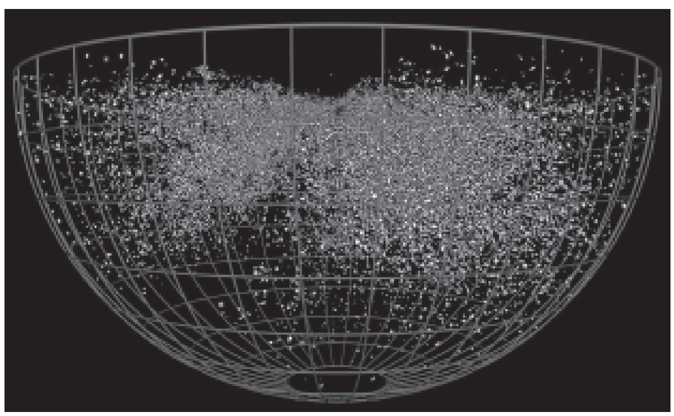
[1] http://www.dest.gov.au/sectors/science_innovation/policy_issues_reviews/reviews/anglo_aus.htm

[2] http://www.atnf.csiro.au/nca/DecadalPlan_web.pdf

Science

Significant scientific contributions were made by both the AAT and the UKST in 2005–06. This year saw the final observations taken for the 5-year 6dF Galaxy Survey (6dFGS), which has measured spectra for 124,000 galaxies over most of the southern sky. This survey provides the most detailed map to date of the local universe and, in combination with a less-deep survey of the northern hemisphere, the best all-sky galaxy redshift catalogue. For about 10% of the galaxies in the 6dFGS it is also possible to measure their motions, giving a map of the galaxy velocity field 10 times more detailed than any before. Together the redshift and velocity maps are expected to yield better estimates of the total mass density in the universe, and also provide new insights into the relationship between the luminous galaxies and the unseen dark matter.

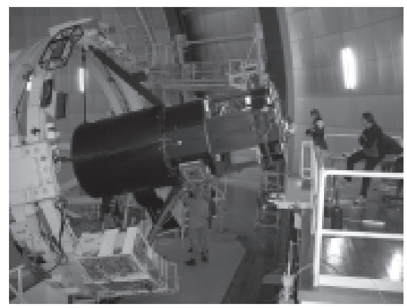


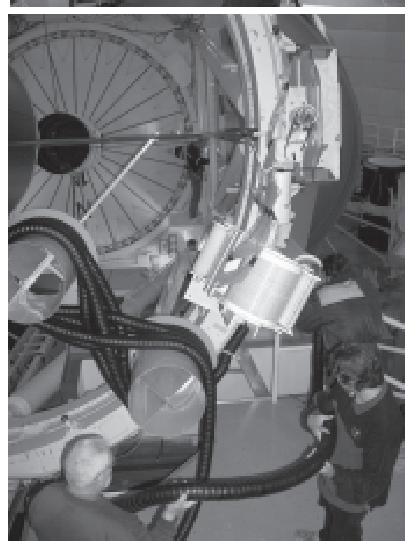
An image of the 6dF Survey volume by Paul Bourke of the Swinburne Centre for Astrophysics and Supercomputing.

As the 6dFGS was coming to a conclusion, the other UKST observing program – the Radial Velocity Experiment (RAVE) – ramped up to full use of the telescope. RAVE is measuring the velocities and chemical make-up of up to one million stars in order to understand how our own galaxy, the Milky Way, was formed. The first data release from the RAVE project was made public in early 2006. This project, like the 6dFGS, is an international collaboration involving a large team of astronomers from many countries, and is expected to continue for some years.

The AAT science highlights were also associated with large surveys. One of these was a survey of the gas, dust and plasma that makes up the interstellar medium that fills the space between the nearby stars. This used the AAT's unique Ultra-High Resolution Facility (UHRF) – the highest resolution astronomical spectrograph in the world – to map the interstellar medium in the southern hemisphere. Together with similar observations in the north, the survey delineates the structure of wisps, voids and bubbles created by the processes involved in the births and deaths of stars. This work will lead to a better understanding of how stars (and planetary systems) interact with their environments.

Other AAT science highlights this year were associated with the first observations with the new AAOmega spectrograph, and include an study of an ancient galaxy, seen at a time when the universe was less than a tenth its present age, and the detection of a very unusual, and highly energetic, type of star, caught in the act of blowing off its outer layers. The first observations were also taken for the WiggleZ survey of high-redshift, star-forming galaxies. This survey aims to map 400,000 galaxies at redshifts around z=0.5-1.0 in order to detect the effects of dark energy on the galaxy distribution at an epoch when the expansion of the Universe was decelerating, before the dark energy became dominant and caused the expansion to accelerate. The goal of the project is to determine whether the dark energy remains constant with time or evolves – the former case would correspond to Einstein's 'cosmological constant', while the latter would be a crucial clue to fundamentally new physics.

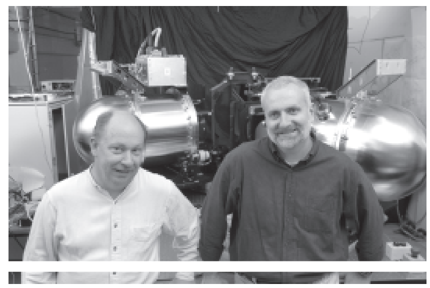




Top: Preparing to uncoil the AAOmega fibre bundle from the telescope for the first time - keenly watched by many members of staff. Bottom: Uncoiling the AAOmega fibre bundle and sending it on its long journey through the telescope structure down to the AAOmega spectrographs. Photos Steve Lee

Operations

The major event at the telescope in the past year was the advent of the AAOmega spectrograph, which was commissioned in December and January and started science observations in February. The commissioning period required a major effort by the instrument team and telescope operations staff, but was a resounding success. Astronomers using AAOmega were loud in their praises for the new instrument, which is now the most-demanded facility on the AAT. The SPIRAL integral field unit for AAOmega was commissioned in June, and was also rapidly in scientific use.



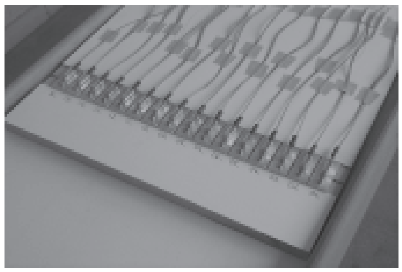
Sam Barden, Head of Instrumentation and Matthew Colless, Director, with AAOmega in the background Photo David Smyth

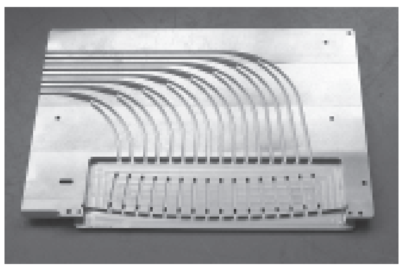
Other significant operational changes were the formation of the joint Anglo-Australian Time Allocation Committee (AATAC), which first came into operation for the second semester of 2005. This merger of the formerly separate Australian and British time allocation committees went remarkably smoothly, and is generally acknowledged to provide significant efficiencies in awarding time on the AAT.

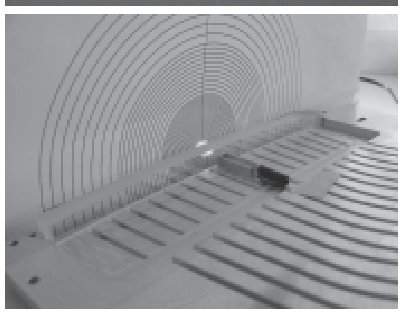
One particular advantage of AATAC is the avoidance of the problem of ‘double jeopardy’ when submitting joint Australian/UK observing proposals. This was particularly important in the first semester of 2006, when the new Large Observing Programs were first up for allocation. In that semester AATAC awarded large-program status (involving a long-term commitment of large amounts of AAT time) to the Anglo-Australian Planet Search and smaller amounts of time for pilot studies for four other large programs using AAOmega. For the second semester of 2006, AATAC has chosen one of these four projects (the WiggleZ survey described above) for large-program status. These large observing programs are expected to produce high-impact flagship science for the AAT in coming years.

Instrumentation

With the successful completion of AAOmega and SPIRAL, the AAO's instrument group were focussing on the future during much of 2005–06. Two major new projects were under consideration: the Wide-Field Multi-Object Spectrograph (WFMOS) for Gemini and a new instrument for the AAT.







Top: SPIRAL slitlets each with 32 fibres glued awaiting IFU cable assembly. Centre: SPIRAL slit plate before installation of slitlets or field lens. Photos Chris McCowage. Bottom: A SPIRAL slitlet fibre output alignment being checked against a test graticule. Photo Allan Lankshear

The WFMOS project had both highs and lows during the year. The first high was the award of one of the two US$1.7M Concept Studies to an AAO-led consortium of seven international institutions. The low came six months later, when Concept study when it was suspended due to funding difficulties with the Gemini instrumentation program. At the time of writing, however, these difficulties have been overcome, and a re-start of the Concept Study is being negotiated. WFMOS is important both to AAO's instrumentation program and to the wider Australian astronomy community, as it is the next-generation Gemini instrument with the highest scientific priority.

A new instrument for the AAT, to provide leading-edge capability into the new decade, emerged as one of the high-priority items in the development of the Decadal Plan. The instrument that the AAO has proposed, after consultations with the user community, is a wide-field near-infrared fibre spectrograph dubbed AAOmicron. AAOmicron will utilise the existing 2dF corrector and robot and an adapted version of the AAOmega spectrograph design in order to deliver a highly capable instrument at relatively low cost. As an alternative, the AAO is also planning to study a version of WFMOS for the AAT, in case the Gemini instrument does not go ahead.

On the R&D front, the AAO obtained a significant grant from PPARC to support development of the OH-suppression fibre technology that it has originated. These special optical fibres have the potential to revolutionise near-infrared astronomy by reducing the background emission from the Earth's atmosphere by a factor of 20 to 30, making the near-infrared sky as dark as the optical sky. PPARC funding was also sought during the year for the Starbugs technology, which the AAO believes will be important in meeting the needs of future generations of instruments on large telescopes; the outcome of this bid is expected later in 2006.

Strategic Outlook

Encompassing the new Agreement, the Decadal Plan, the DEST review, the advent of AAOmega and the tribulations of WFMOS, 2005–06 has been an eventful and at times difficult year. Nonetheless, looking forward the view is highly encouraging. The Decadal Plan has mapped out a comprehensive and viable long-term role for both the AAT and the Observatory that, if supported by a positive response to the DEST-funded review, would establish the organization's future on a secure long-term footing. Likewise, the success of AAOmega, the revival of the WFMOS concept study, and the development of a new instrument for the AAT, all give a clear direction to the AAO's instrumentation program, with the seeds of future successes being nurtured in the OH-suppression and Starbugs technologies. Looking back from 2010, it may be that the turmoil of 2005–06 will be viewed as the necessary birth-pangs of the new AAO.

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Review by the Chairman of the Board

Dr Pat Roche,
Chair, AAT Board

With the major results from the 2dF surveys conducted on the AAT now firmly established in the astrophysical research records, it is gratifying to see the first results from the AAOmega spectrographs emerging and confirming the scientific potential of the instrument. The first large programmes are underway, and we look forward to the results in due course. Congratulations to the instrument team for their hard work and dedication in seeing AAOmega through design, integration and commissioning.

Concepts for a new instrument for the AAT are being examined with a view to providing new capabilities at the end of this decade. In the meantime, excellent scientific results continue to be produced, some of which are highlighted in this report. In particular, the final data from

AAOmega instrument team: left to right: David Correll, John Dawson, Greg Smith, Stan Miziarski, Lew Waller, Vladimir Churilov, Matthew Colless, Gabriella Frost, Sam Barden, Ed Penny, Roger Haynes and Denis Whittard: Photo David Smyth

Pictured here at the Institue of Astronomy, Cambridge, are the members of the AAT Board along with some members of the AAO Executive (from left) Mr Greg Harper, Dr Colin Vincent, Prof. Warrick Couch (Deputy Chair), Prof. Brian Schmidt, Dr Pat Roche (Chair), Prof. Matthew Colless (Director AAO), Mr Graham Brooks (retiring Board member), Mr Neville Legg (Executive Officer), and Dr Stephen Warren. Further details of Board members, special responsibilities and Board meetings are included in Appendix D.

the 6dF galaxy survey on the UK Schmidt Telescope have been produced, followed quickly by the first data release from the RAVE survey, demonstrating the effective way that the telescope has been exploited in mapping out the structure of galaxies and our own Milky Way galaxy.

The supplementary agreement to the Anglo-Australian Treaty has been formally approved by both governments allowing a phased reduction in UK contributions. The transition of the AAO from a bi-national Australian/UK facility to an Australian facility in 2010 is now underway. Observing time allocation on the AAT is no longer carried out by separate Australian and UK committees, but by a joint AATAC, whose membership reflects the contributions from the two countries, and which is better suited to the large programmes that will use significant amounts of time with AAOmega and UCLES on the AAT.

A review of the Observatory was conducted in April 2006 by a panel established by the Australian Department of Education, Science and Training to make recommendations on the future role of the AAO. Further changes in the operation of the Observatory are anticipated when the outcomes from this review are implemented. The Board looks forward to working with our colleagues to ensure a smooth transition.

This year, Dr Mike Irwin and Mr Graham Brooks resigned as UK members of the AAT Board and were replaced by Dr Steve Warren and Dr Colin Vincent. We congratulate Prof. Brian Schmidt, an Australian Board member, on the award of a Federation Fellowship.

Anglo-Australian Telescope Board

Appointed by the UK Government

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

Dr Colin Vincent, Head, Astronomy Division, PPARC, indefinite appointment from 5 April 2006

Dr Stephen Warren, Reader, Department of Physics, Imperial College London; appointed 1 March 2006 till 29 February 2008

at 30 June 2006

Appointed by the Australian Government

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

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

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

3. Scientific highlights

The 6dF Galaxy Survey

On 5th January 2006, the 6dF Galaxy Survey, an Australia-led international collaboration, measured the spectrum of its final galaxy, bringing to an end a program of observations spanning five years at the UK Schmidt Telescope. This ambitious survey has mapped the three-dimensional positions of over 120,000 galaxies spanning almost the entire southern hemisphere. The extremely large size of the survey combined with the careful selection of targets make the 6dF Galaxy Survey unique in its ability to determine the properties of the local Universe.

The main scientific goals of the survey are to measure the total stellar mass of the nearby Universe, and to understand its relationship with environment and bulk-flow motions. To facilitate this, targets were selected at near-infrared wavelengths providing a direct link to the luminous mass of the galaxies, and furnishing a catalogue of the most evolved stellar populations. This single feature sets the 6dF Galaxy Survey apart from all other surveys of comparable size, and allows the mass distribution of galaxies to be measured with much greater accuracy than ever before.

A subset of the sample comprising about 15,000 elliptical galaxies have had their masses directly determined using spectroscopic techniques to measure the velocity dispersions of the stars in the galaxies. This sample is again of unprecedented size and coverage, and the more detailed spectroscopy allows one to infer the peculiar motions of the galaxies. Thus the detailed three-dimensional distribution, the masses and the motions of the galaxies will all be known, providing unrivalled knowledge of the behaviour of galaxies in the local Universe, and supplying strong constraints for galaxy formation theories.

The final data release of the survey represents the culmination of many years of hard work by all involved. The instrument design, survey strategy, software development, observations, exhaustive quality control and book-keeping are all serious challenges for a survey of this magnitude. The legacy of the survey, however, will be a publicly available database, with a sky-coverage surpassing all other surveys of equivalent depth for the foreseeable future.

Figure 3.1 shows the map of the survey field coverage as it stands at the end of the survey. The survey has essentially covered the entire southern sky, with the exception of the 'zone of avoidance' where the view is obscured by our own Galaxy.

The 6dF Galaxy Survey will have a major impact on our understanding of galaxy-formation processes, which are still rather poorly understood and of enormous importance in the evolution of the Universe. One fundamentally important question in this field is:

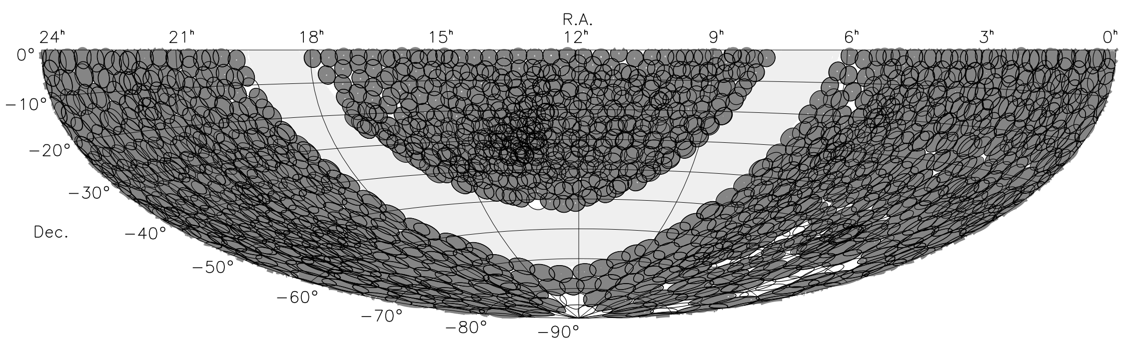


Figure 3.1. A map of the Southern hemisphere sky showing the 6dF Galaxy Survey coverage. Open circles denote all fields on the target list and filled circles denote those comprising the survey.

how frequently do galaxies of various mass occur? The 6dF Galaxy Survey offers by far the best answer to this question for the nearby Universe so far. The sheer size of the survey means the catalogue is a representative sample of the Universe, and the near-infrared measurements of galaxy luminosity are much more closely correlated with galaxy mass than optical luminosities used in all other surveys of comparable size.

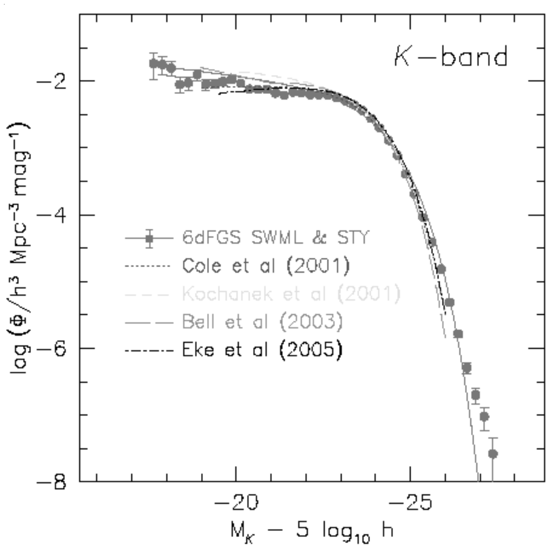


Figure 3.2. The number density of galaxies is plotted as a function of their near infrared luminosity, shown by the points. The brightest and therefore most massive galaxies appear on the right of the plot, and are fewer in number than the least massive galaxies on the left hand side. The solid line shows the best fitting model. The other lines are the best fitting models from other surveys, shown for comparison.

The final determination of this relation from the 6dF Galaxy Survey has not yet been made, but in Figure 3.2 we show the answer using roughly two-thirds of the data. The number density of galaxies is plotted as a function of their near-infrared luminosity (i.e. equivalent to stellar mass). The brightest, most massive galaxies are on the right of the diagram, and are comparatively rare. The number density of less massive galaxies increases rapidly, and then flattens off, increasing moderately to the limits of the data. The precision of these numbers provides a strong constraint for models of galaxy formation processes; they must be able to reproduce this distribution.

Of particular interest in Figure 3.2 is the slight upturn in galaxy numbers at the bright-end compared to the best fitting models. This excess of very luminous objects is thought to be due to the brightest galaxies in clusters, which form via unique merger and accretion processes that come into effect in very dense environments. The galaxies responsible for this upturn have been examined in detail. Figure 3.3 shows some examples of these galaxies: the main panel shows their spectra detailing their chemical make-up, and the inset images are from two different imaging surveys. The imaging reveals that there are a number of close galaxy pairs in this sample supporting the idea that many of these galaxies inhabit dense environments.

These are but a couple of examples of the science that may be tackled with this singularly large and capable survey. Following the public release of the final catalogue we anticipate a rich heritage of new results and papers, forming a fitting tribute to this chapter of the history of the UK Schmidt Telescope.

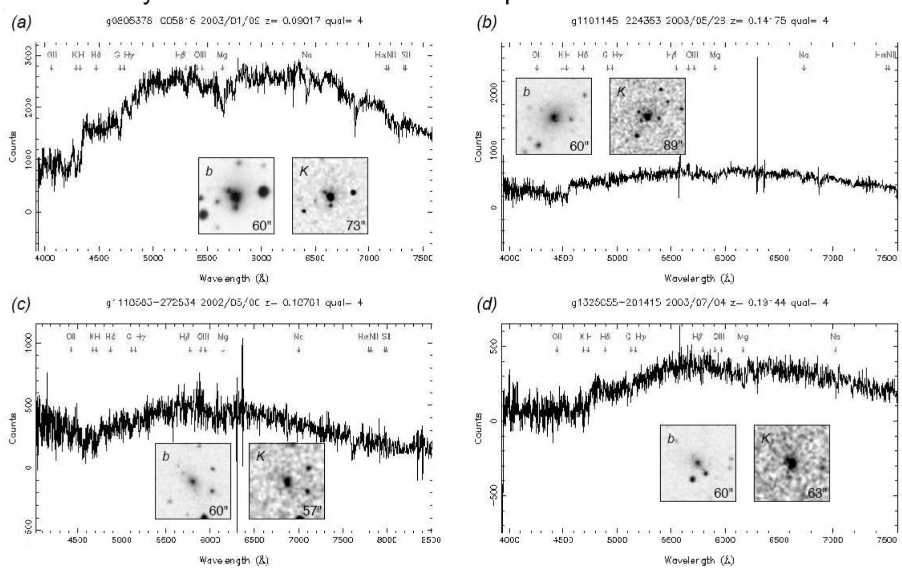


Figure 3.3. Examples of the most luminous galaxies in the survey. The main panel shows the spectra of the galaxies revealing their chemical compositions. The inset images reveal that the galaxies have many close neighbours, and therefore inhabit very dense regions of the Universe. The extremely dense environment may lead to a significant increase in the number of mergers and thus result in more massive and luminous galaxies.

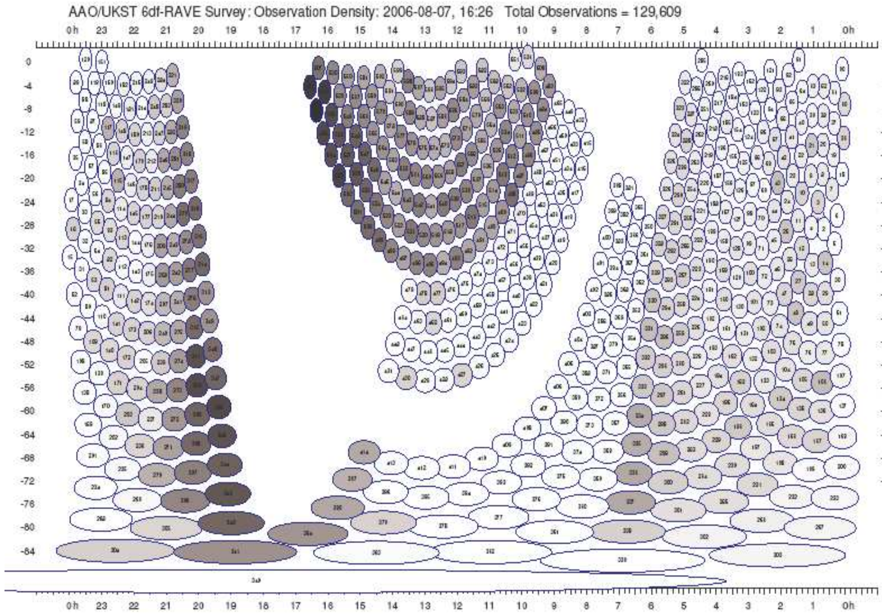


Figure 3.4. A map of the southern sky showing the status of RAVE observations as of December 12th 2005. The shading corresponds to the number of stars observed in each field, with white=0 and black=550 stars.

The Radial Velocity Experiment

Studies of our own Galaxy provide a level of detail about astronomical processes that is simply impossible to measure in other galaxies. This is particularly true for the study of the stellar populations of galaxies; only the brightest stars are observable in even the nearest external galaxies. Thus if we are to understand star-formation and galaxy-formation in any detail we must turn our attention to our own Galaxy.

The RAdial Velocity Experiment (RAVE) is an ambitious spectroscopic survey of the southern hemisphere, designed to capitalise on the detailed observations of stars that are possible within the Galaxy. It will measure radial velocities and stellar atmosphere parameters (temperature, metallicity, surface gravity) of up to one million stars using the 6dF multi-object spectrograph on the 1.2m UK Schmidt Telescope of the Anglo-Australian Observatory. The survey is being undertaken by a multinational team involving scientists from Australia, Canada, France, Germany, Italy, the Netherlands, Slovenia, Switzerland, the UK and the USA.

RAVE is the only planned systematic survey of velocities that will provide continuous coverage of a substantial fraction of the galaxy until the space-based

GAIA mission at the end of the next decade. Thus, RAVE is an essential survey to release the clues to the history of our Galaxy that are locked up in the motions and chemical compositions of the stars in the Milky Way. We will be able to deduce where and when different groups of stars were born.

The main scientific goals of RAVE are:

- To provide an unrivalled database of stellar motions and chemical compositions of Galactic stars. The resulting database is expected to be at least one hundred times larger than current databases.
- To identify 'stellar streams', groups of chemically related stars moving together as a result of smaller satellite galaxies falling into, and being subsumed by, the Milky Way.
- To determine how the structure of the Milky Way influences local stars, particularly the effects due to the spiral arms and the inner bar of the Galaxy.
- To measure in detail the shape of the Galaxy, including the ellipticity, the warping and lop-sidedness of the disc.
- To determine the overall mass of the Milky Way from the first non-local measurements of the surface density of stars in the disc and their collective gravitational force.
- To study the detailed structure of the disc of the galaxy, including features such as the spiral arms and small associations of stars.

Survey design and status

So far RAVE has measured spectra for 120,165 stars in the local neighbourhood, and has undergone extensive data processing and catalogue validation checks. In July 2005 RAVE entered into full-scale operation, and data are now being obtained on every useful night of the year. At the current rate of observations RAVE should meet its target of one million stars by 2010. The current status of observations is mapped in Figure 3.4.

The first catalogue of data was released in mid 2006, containing velocities for 24,789 stars. A dedicated software pipeline has been developed by the RAVE team to properly account for instrumental effects, calibration, and extraction of the spectra. The success of this software results in stellar velocities measured to an accuracy of +/- 3 km/s. This level of precision is more than enough for almost all studies of galactic kinematics and dynamics. This is illustrated in Figure 3.5 showing the radial velocities measured in 428 targets observed multiple times by RAVE.

The release of the first catalogue represents the first step of the journey to the largest spectroscopic survey of stellar properties ever undertaken, allowing an unprecedented understanding of our own Galaxy.

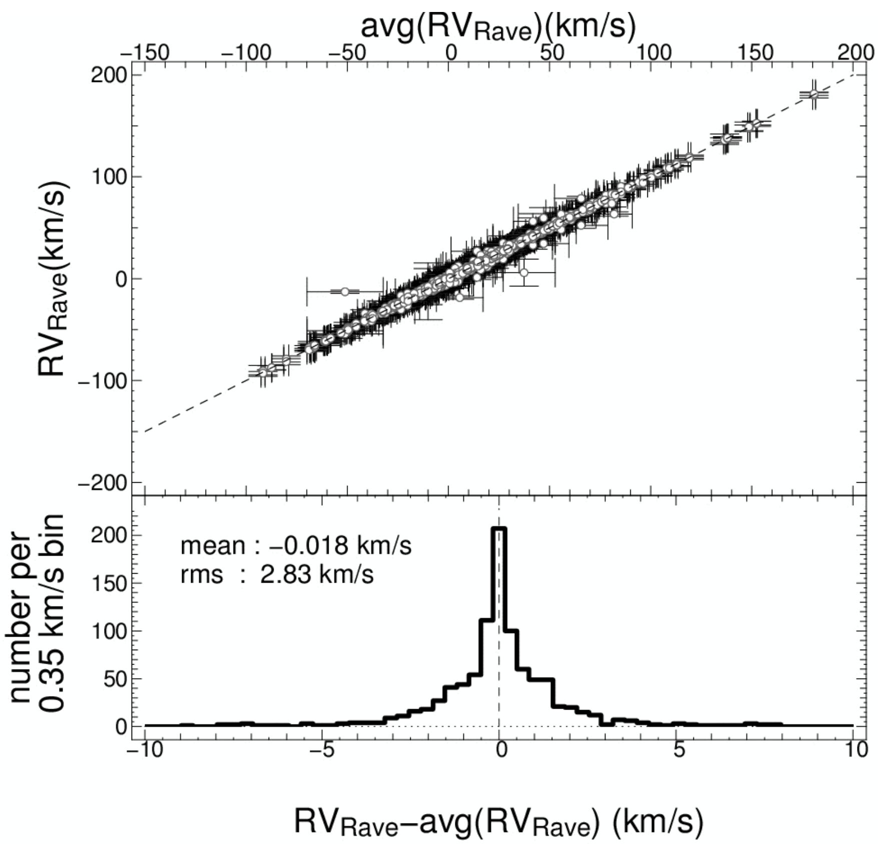


Figure 3.5. The accuracy of the observations has been measured via repeated observations of 428 targets. The top plot shows the radial velocity measured in single observations compared to the average velocities measured. The bottom plot shows the scatter around the relation, and shows that the average accuracy of the measured velocities is +/- 3km/s.

AAOmega: the AAT's newest instrument

The year 2005-06 saw the beginning of a new chapter of observations on the AAT, with the successful commissioning of AAOmega, a new spectrograph and the AAT's newest instrument. Whereas conventional astronomical instruments are attached to the telescope, AAOmega is located on a separate floor from the telescope, and fed by 39 metres of fibre optics. This location away from the moving telescope provides a very stable, temperature-controlled platform, which, combined with greatly improved components and design, results in an efficiency 2-3 times higher than that of the original 2dF spectrographs.

AAOmega can be used in two modes. It can be used with the 2dF robotic fibre positioner to measure the spectra of up to nearly 400 objects simultaneously, providing insights into e.g. the distribution of galaxies in the Universe, the chemical composition of stars and the star-formation history of galaxies. Alternatively it can be used with the SPIRAL integral field unit allowing 3 dimensional spectroscopy of a single object, i.e. measuring a spectrum from a grid of locations across the image, for example to look at star-formation within different parts of a galaxy.

Although observations with AAOmega have only recently begun, its efficiency and stability have already been dramatically demonstrated. We highlight its capabilities with two examples below.

A very high redshift galaxy

Figure 3.6 shows the spectrum of a galaxy at redshift 5.721, i.e. the light was emitted at a time when the Universe was only 1.1 billion years old, less than a tenth of its present age. Thus the light has taken over 12 billion years to reach the Earth. Although this galaxy was previously known, these observations demonstrate the feasibility of detecting such high redshift objects with the 3.9m AAT, a task that was previously considered to require at least an 8m telescope.

The serendipitous detection of a Wolf-Rayet star

Wolf-Rayet stars are an extremely energetic class of stars that produce so much energy they literally blow away their outer atmospheres. Planetary nebulae are bright clouds of glowing gas and dust surrounding a highly evolved star. Less than one hundred planetary nebulae are known to have a central Wolf-Rayet star. Quentin Parker, of the AAO and Macquarie University, is leading an international team searching for planetary nebulae in a survey undertaken with the AAO operated UK Schmidt Telescope. In a recent AAOmega-SPIRAL programme to look in detail at a sample of

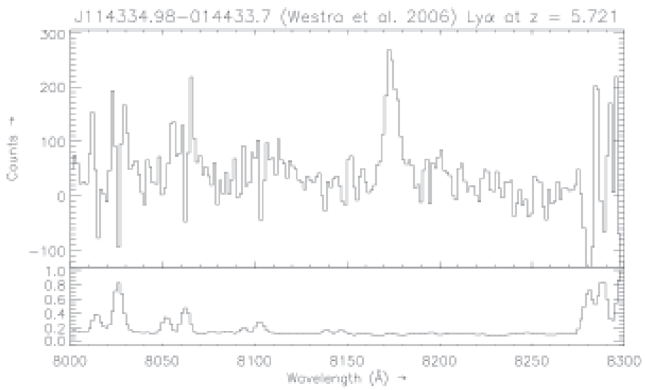


Figure 3.6. An AAOmega spectrum of a galaxy in the very early Universe. The obvious spike is produced by hydrogen and allows the distance to the galaxy to be determined. This ~4 hour long exposure demonstrates the capability of AAOmega to detect such high redshift objects.

planetary nebula, Parker and colleagues serendipitously discovered a new example of an exceedingly rare planetary nebula with a central Wolf-Rayet star. Figure 3.7 shows the observations.

Large surveys

Whilst the above examples demonstrate AAOmega's capabilities, its biggest advantage will be in large survey work. With a two degree field-of-view, the capability to measure spectra of 400 objects simultaneously and the high quality of the obtained data, AAOmega is the perfect machine for large area galactic and extra-galactic spectroscopic surveys, an example of which is the recently begun 'dark energy' survey that is described in this chapter.

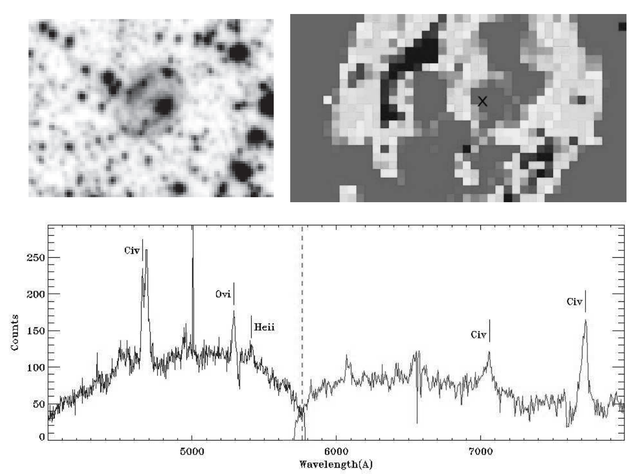


Figure 3.7. AAOmega-SPIRAL observations of a new planetary nebula discovered in the AAO/UKST H-alpha Survey. The top left panel shows a greyscale image of the nebula, which is seen as the elliptical shaped nebulosity at the centre. The top right panel shows a reconstructed image using only the narrow wavelength range corresponding to the hydrogen emission. The cross marks the position of the central star and is devoid of any hydrogen emission. The bottom panel shows the spectrum of the central star, revealing it to be a Wolf-Rayet star, of which fewer than 100 are known in planetary nebulae.

Unveiling dark energy

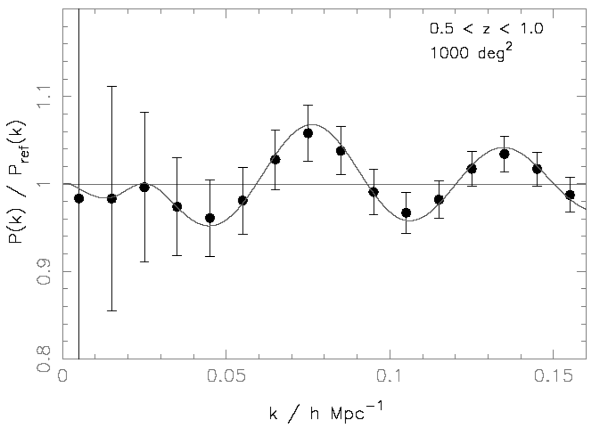


Figure 3.8. Any dark energy present in the Universe will affect the distribution of galaxies. This simulation shows the expected variation of galaxy numbers as a function of spatial frequency (i.e. 1/distance) if dark energy exists.

Towards the end of the last century a major upheaval of our understanding of cosmology began. Separate teams, using different techniques, found that the expansion of the Universe is accelerating, with profound consequences. Prior to this discovery it was believed that the expansion should be slowing down due to the retarding, attractive effects of gravity counteracting the expansion. The fact that this is not the case is of enormous importance to our understanding of the Universe. The most likely explanations are either that the theory of gravity, as developed by Einstein, is flawed and must be revised, or the content of the Universe is dominated by an exotic form of 'dark energy', which has the peculiar property of repelling matter, like a sort of anti-gravity. In either case, the result would be a major change in our understanding of the Universe, and solving this problem is regarded as one of the most pressing issues in physics.

A team of scientists, led by Michael Drinkwater of the University of Queensland and Warrick Couch of Swinburne University are working with the AAOmega spectrograph on the AAT to tackle this challenge. The key to the solution lies in the way the distribution of galaxies is related to conditions in the early Universe. Very early in the history of the Universe, the distribution of matter was very smooth. Over time small 'seed' fluctuations in the density began to grow via accretion of matter through gravitation. The manner in which these grow depends on the energy content of the Universe, including both gravity and any 'dark energy' present. The fluctuations eventually collapsed to become galaxies. The link between seed fluctuations at early times, imprinted on the cosmic microwave background (the heat glow from the Big Bang), has now been explicitly linked to the present day distribution of galaxies, by scientists working on data from the 2dF spectrograph at the AAT. However, to see the effects of 'dark energy' we must look to galaxies at earlier times. Figure 3.8 shows the expected signal due to dark energy.

Using the newly commissioned AAOmega spectrograph at the AAT, Drinkwater, Couch and colleagues are the first team in the world to begin measuring the link between galaxies and dark energy. Measuring the exact locations of about 400,000 galaxies early in the Universe will provide enough sensitivity to measure the effects of any dark energy, thus either confirming or refuting its existence. Whilst a survey of this magnitude is a long-term project, preliminary results obtained in February 2006 have demonstrated the feasibility of the study, and the capability of the AAOmega instrument to perform the task. Figure 3.9 shows a composite spectrum of galaxies observed with AAOmega during a pilot study, demonstrating the strong emission lines required for the study.

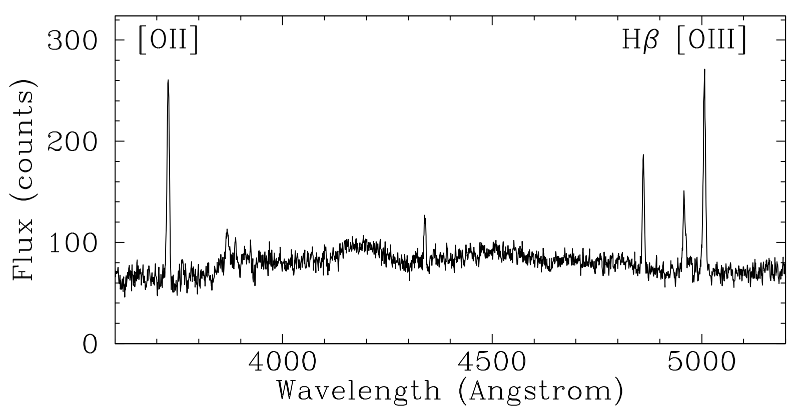


Figure 3.9. A composite spectrum of galaxies observed with AAOmega during a pilot study, demonstrating the strong emission lines required for the study. To make this high quality composite spectrum, the spectra of many galaxies at different distances have been combined.

A Survey of our Local Environment

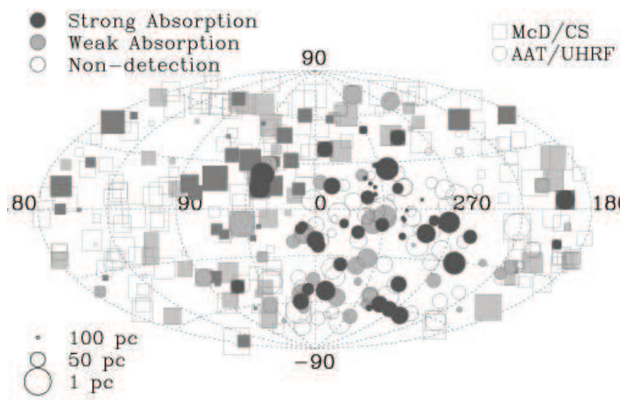


Figure 3.10. A map of the entire sky showing the regions of the interstellar medium observed. The size of the symbols corresponds to the distance of the background star, with smaller symbols being more distant. Circular symbols are from the UHRF on the AAT, whilst squares are from the northern hemisphere McDonald Observatory. The shading represents the amount of absorption, or equivalently the density of the local interstellar medium in that direction. Darker areas represent stronger absorption and denser material.

Contrary to common belief, space is not empty. Between the stars there exists material, albeit a very diffuse and thin material, consisting of 99% gas and 1% dust (small particles of matter). Despite its sparse nature, the influence of the interstellar medium may be profound. It has been speculated that the motion of the Sun through different interstellar environments may cause dramatic variations in the number of cosmic rays entering the top of the Earth's atmosphere, influencing cloud-cover, ozone layer chemistry, atmospheric electrical activity, biological mutation rates and long-term climate variability. Furthermore the nearby interstellar medium may be mapped in three dimensions, providing the opportunity to study the physical processes that occur in the interstellar medium throughout the Galaxy. Another reason to study the local interstellar medium is to allow observers of more distant gas clouds to properly disentangle the effects of nearby variations in gas and dust content, allowing more accurate measurements of absorption and distances to the systems in question.

An American team, led by Seth Redfield from the University of Texas, has been using the AAT to map the interstellar medium within the solar neighbourhood. Combined with a similar survey in the north, they have mapped the interstellar medium over a large fraction of the sky. This is achieved by measuring the absorption of light from 400 nearby stars due to the intervening gas and dust.

The observations with the AAT have used the Ultra High Resolution Facility (UHRF), the highest resolution astronomical spectrograph in the world, capable of resolving velocities of 0.3 km/s. Figure 3.10

shows the observed regions of the sky and the amount of absorption detected. The amount of absorption corresponds to the density of the interstellar medium at that point. The results show that the local interstellar medium is neither randomly distributed nor is it ubiquitous. Large regions of the sky are devoid of any detections, whereas clear concentrations of dense gas are observed toward many adjacent sightlines. There also exist small-scale variations as shown in Figure 3.11, comparing two adjacent sightlines only 2.2 degrees apart but having very different absorption spectra, despite the fact that the two stars are at very nearly the same distance from the Sun (68.8 and 70.7 pc).

This survey will provide the most densely sampled survey of absorption from the local interstellar material. Future analysis of the dataset will greatly advance our understanding of the distribution and physical characteristics of material in the solar vicinity. This will lead to a much better appreciation of the environments of the Sun and most of the known exoplanetary systems and the relationship between them.

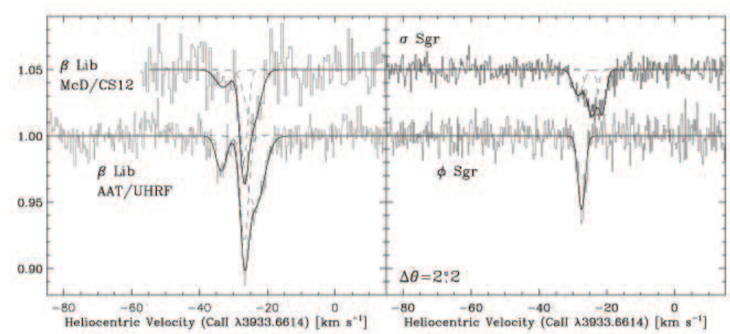


Figure 3.11. Absorption spectra of two close adjacent regions on the sky. The left hand panel shows the absorption against the same star, the top spectrum from the northern hemisphere McDonald Observatory and the higher quality bottom spectrum from UHRF on the AAT. The right hand panel shows absorption against two different, but close by stars, measured with UHRF. The absorption is clearly different despite the fact that the sources are at very nearly the same distance and are only 2.2 degrees apart on the sky. The differences in the spectra indicate that the interstellar medium varies on small scales.

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 committee, 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.

It is in the AAO's own interests 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.

It will be seen that the oversubscription for dark time has surged, as foreshadowed last year, due to the commissioning of AAOmega, and the special calls for Large Observing Programs, most of which involve AAOmega. It is comparable with the spike in the oversubscription rate 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 4.1 Oversubscription rates for the AAT

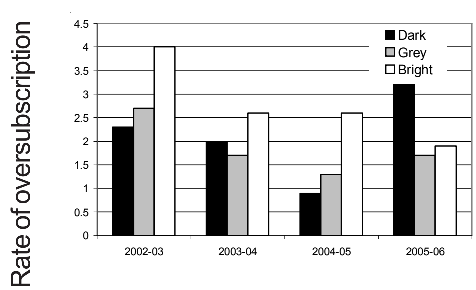


Figure 4.2 The use of observing time at the AAT in 2005–06

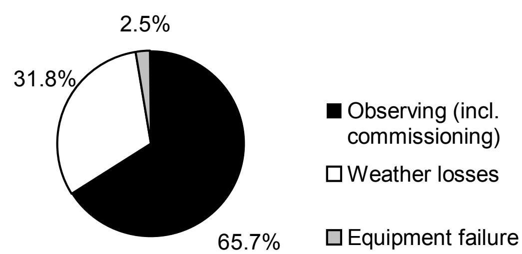
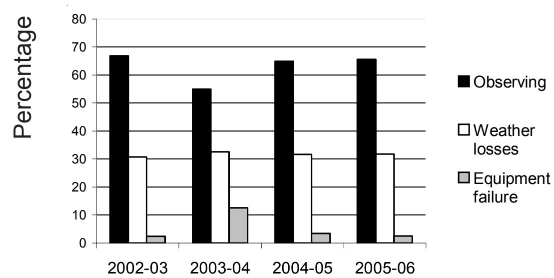


Figure 4.2 shows the use of observing time during the period 1 July 2005 to 30 June 2006. A total of 3,125 dark hours were available, and an additional 166 hours of commissioning time were used. The continuing trend of good weather conditions associated with the drought experienced in eastern Australia 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 is now within the AAO's target level of 3%. The higher rates of time loss in the previous two years were largely due to specific causes: the catastrophic failure of a dome shutter drive shaft during 2003–04, and recurring 2dF robot problems during the first half of 2004–05.

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



User Feedback

All AAT and UKST 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) acceptable 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 2005 to 30 June 2006, 60% of users completed feedback forms for the AAT. This response is at the upper end of the average range (50–60%). 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 errors on these mean grades are ~0.2. They show that the level of satisfaction is generally high, and fairly consistent over the three years.

The AAO Corporate Plan sets a goal of a score of at least 3.5 in all categories. All performance areas have met that target in 2005–06. General computing, traditionally the weakest area in the reply categories, has responded well to strategic IT initiatives. The disappointing score for Data Reduction Software resulted primarily from UCLES observers having to cope with the inherent complexity of the échelle wavelength format early in the reporting year. Library Facilities has been discontinued as an area for comment as most users of the telescope now look at the literature on-line rather than in the AAT library. 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.

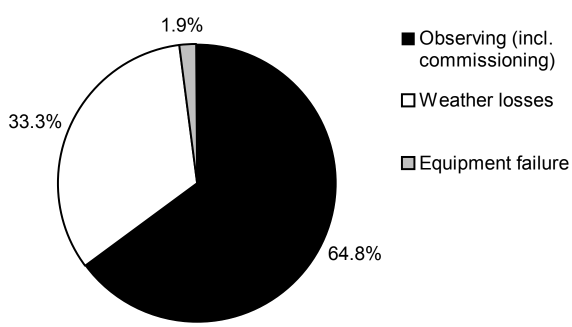
Table 4.1 User Feedback at the AAT

	2003–04	2004–05	2005–06
Night Assistant support	4.7	4.8	4.7
Staff astronomer before	4.3	4.5	4.7
Staff astronomer during	4.5	4.6	4.8
Other technical support	4.1	4.2	4.3
Instrumentation & related software	3.7	4.0	3.9
General computing	3.4	3.7	3.8
Working environment	3.9	3.9	3.9
Travel & administrative support	4.1	4.0	4.0
Data reduction software	3.9	4.1	3.6
Instrument manuals	3.9	4.1	3.9
Library facilities	3.7	3.7	n/a
AAO WWW pages	4.0	4.1	3.9

UK Schmidt Telescope Organisational Statistics and Performance Indicators

Figure 4.4 shows the use of UK Schmidt Telescope

Figure 4.4 The use of observing time at the UKST in 2005–06



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.

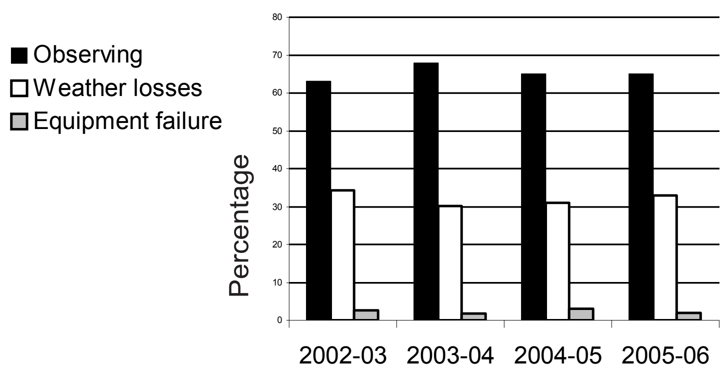


Figure 4.5 The use of observing time at the UKST

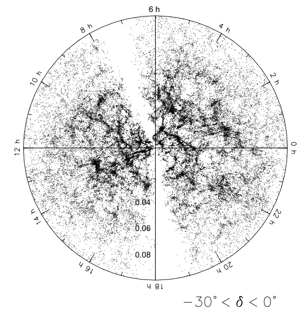
System-loss statistics were normal. The 6dF instrument, now five years old, has attained a very stable operating mode with only fibre breakages presenting problems of reduced efficiency. These are rectified by means of an ongoing maintenance program, which removes one or the other of the two field plates from service for short periods while fibre repairs are effected.

The 6dF program has occupied all UKST 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 (hrs)

	2001-02	2002-03	2003-04	2004-05	2005-06
6dFGS fields	261	351	392	383	94
RAVE fields	-	47	320	407	726
Non-survey fields	124	162	118	112	2
Total fields	385	560	830	902	822
Total exposure	713	1078	1219	1288	826

Observations for the 6dF Galaxy Survey (6dFGS) were completed during the reporting year, with the final observations being made on the night of 5 January 2006. Despite some trading of nights with the RAVE survey (see below), there remained ~50 fields outstanding at the end of the survey due to poor weather during the second half of 2005.



A view of the 6dF Galaxy Survey

From 11 April 2003, seven unscheduled bright-of-moon nights per month were allocated to the international RAVE survey of stellar radial velocities and metallicities, which funded the time externally. On 1 August 2005, however, responsibility for funding all UKST operations was taken over by the international RAVE consortium, although the telescope continues to be managed by the AAO.

With new funding arrangements in place for the UKST, the AAO-supported non-survey program came to an end. The final observations were made during the August 2005 bright-of-moon period for the Kuiper belt occultation program (Saunders, AAO, et al.)

The new funding arrangements allow 25 nights per lunation to be used by RAVE, with 20 of those supported by AAO observers and the remainder by visiting RAVE observers. By the end of the reporting year, a total of 1500 RAVE fields (telescope pointings) had been observed, yielding 131,863 spectra for 120,165 stars. A total of 11,698 spectra are repeat observations, obtained either as part of the data validation process for the first data release, or as test samples for the detection of variability or spectroscopic binaries. (RAVE exposure times are shorter than those for the 6dFGS, resulting in the fall in the total hours seen in Table 4.1.)

The RAVE First-Year Data Release (DR1) was announced at the AAS meeting in Washington in January 2006, and in February became publicly accessible on the RAVE website (www.rave-survey.org). It consists of 25,274 radial velocity measurements of 24,789 stars obtained during the first year of operation (11 April 2003–3 April 2004). The mean velocity accuracy is 2.7 km/s, and the dataset is unique in stellar astronomy in having been obtained with a consistent instrumental set-up.

The new funding arrangement will continue for the duration of the RAVE project (which has set a target of one million stars, and is expected to continue for at least five years). The UKST is no longer available to external users, except by special arrangement with the AAO and the RAVE consortium.

Research

Research and organisational statistics

There were 11 research astronomers on the staff of the AAO at 30 June 2006. 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 astronomical research effort is about four people. In addition, there are three externally funded research fellows, and one emeritus astronomer. AAO research staff also co-supervise 16 PhD students from institutions including Sydney University, Macquarie University, and the ANU.

The total number of AAT observing programs for the past five years is shown in Figure 4.6. This continues the long-term trend for a decreasing number of observing programs as a consequence of AAT Board policies to promote large survey-style programs at the AAT, with the average length of an observing run now approaching six nights.

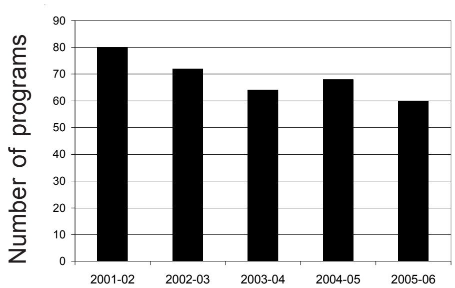


Figure 4.6 Total number of scheduled AAT observing programs. Note that long-term proposals are counted for each semester they are scheduled

Figure 4.7 shows the distribution of AAT observing programs by location of the Principal Investigator (PI). The proportion of successful proposals from UK PIs is now approximately even with that of Australian PIs and is likely to continue dropping as the UK's share of AAT observing time is further reduced.

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

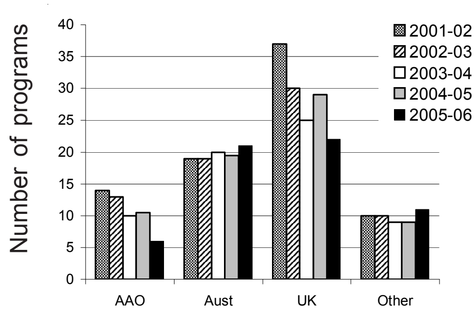


Figure 4.8 shows the total number of research papers published in refereed journals and conference proceedings using data from the AAT and the UKST. Also shown are the total number of AAO papers, published by AAO staff, students and visitors. In total, 95 AAT data papers, 29 UKST data papers and 92 AAO papers were published. While down slightly on the record levels achieved in the previous couple of years, this may just signify the ramping-down of studies utilising the 2dF redshift survey data, and preparation for the next generation of surveys utilising AAOmega. Publications by AAO staff, utilising data not just from the AAT and UKST but also from international facilities such as the Gemini Observatory, have also maintained a healthy level.

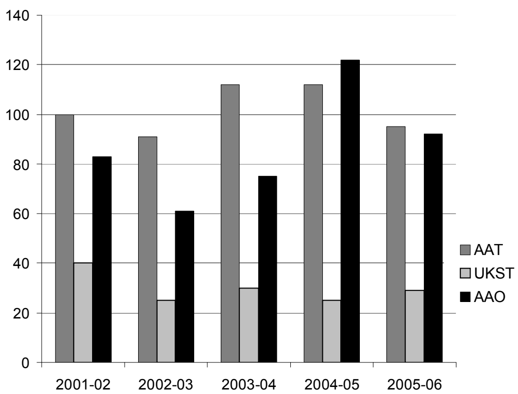


Figure 4.8 Total number of publications using AAT and UKST data, and AAO publications

The distribution of publications in refereed journals by location of the First Author is shown in Figures 4.9 and 4.10 for papers using AAT data and UKST data, respectively. The conclusion of the 6dF Galaxy Survey, and the First-Year Data Release from the RAVE survey, have contributed to a boost in UKST publications, particularly among Australian researchers.

Figure 4.9 Research papers published using AAT data by location of First Author

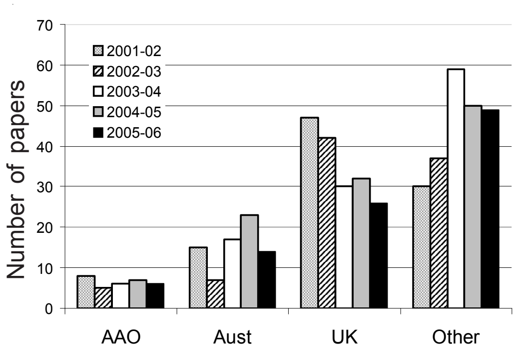


Figure 4.10 Research papers published using UK Schmidt data, by location of First Author.

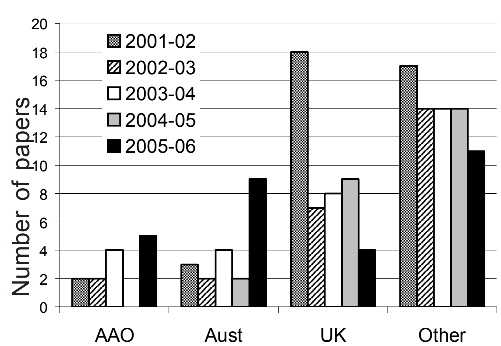


Figure 4.11 gives the number of AAO publications by AAO staff, students and visitors. This is sorted into papers making use of AAT data; UKST data; and papers involving data taken elsewhere (e.g. Gemini, ATNF, etc.), new theories or computational modelling, or new instrumentation technologies under development at the AAO. In all, some 168 unique refereed or conference papers were either published by AAO staff, or made use of AAT or UKST data, in addition to 4 articles in the popular press.

Figure 4.11 AAO publications by AAO staff, students and visitors

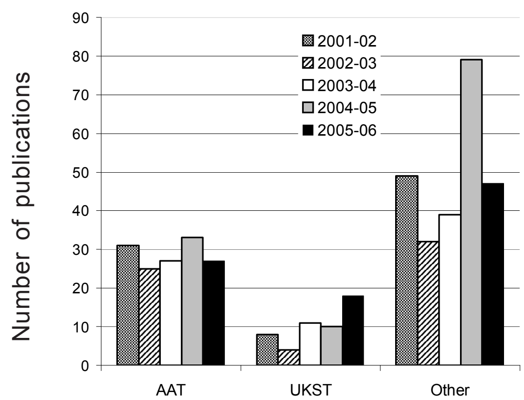


Figure 4.12 shows how well AAT observing programs are converted into scientific papers. To allow for the delay between observations and publications, the statistic given here is the number of publications in a given year divided by the number of scheduled proposals in the previous year. While down slightly on the record levels achieved in 2003–05 as noted earlier, this figure is still nearly double that achieved in 2000–01, an impressive gain in productivity and scientific impact.

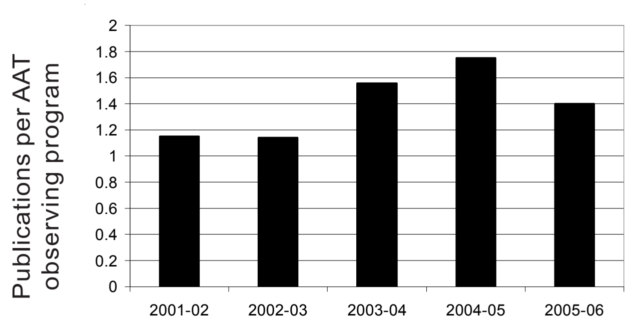


Figure 4.12 Publications per AAT observing program

Instrumentation

The AAO spends about 15 per cent 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	2003-04	2004-05	2005-06
2dF/AAOmega#	33.9	33.0	25.3
UCL coude échelle spectrographs (UCLES & UHRF)	23.9	31.3	45.7
Infrared imager/spectrograph (IRIS2)	24.5	26.3	21.5
WFI	2.8	2.5	1.6
TTF++	47.0	-	-
RGO++	43.0	-	-
SPIRAL integral field spectrograph++	0	-	0.9
Instruments supplied by users	5.9	6.9	5.0

*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).

#2dF was unavailable in the last half of 2005 and was made available with AAOmega in the first half of 2006.

++TTF, RGO and SPIRAL were decommissioned in 2003–04. SPIRAL was recommissioned for use with the AAOmega Spectrograph in June 2006.

Usage of the 2dF multi-fibre spectrograph was down on previous years while the robotic fibre positioner was undergoing refurbishment in preparation for the arrival of the new AAOmega general-purpose optical spectrograph. The introduction of AAOmega has also enabled the fibre-fed integral field unit SPIRAL to be returned to service. Demand for the near-infrared imager and spectrograph IRIS2 remains strong, particularly for following up Galactic Plane sources discovered by the Spitzer infrared space telescope. Both of the high-resolution optical spectrographs UCLES and UHRF are also quite popular, with UCLES continuing the search for extrasolar planets; measuring the composition of stellar atmospheres; and ‘listening’ to the sound of stars ringing like a bell. A small fraction of the time is used by visiting instruments, notably the French-built Semel Polarimeter which can map ‘starspots’ and magnetic fields on nearby stars.

The science-grade infrared array detector in IRIS2 suffered a catastrophic failure during a warmup/cooldown process in May 2005. Although the AAO’s backup detector kept the instrument in service despite this problem, the manufacturer agreed to supply a replacement at no cost, which was installed in IRIS2 in time for on-sky commissioning in May 2006. This new array performs as well as the previous science-grade array, with much better cosmetics and lower noise than the engineering-grade array used in the interim. An image of the Galactic star-forming region G15.03-0.68, taken with the new array, is shown at right.

The past year has also seen the successful commissioning of AAOmega, the AAT's new medium-resolution optical spectrograph for use with 2dF and SPIRAL. The transition of instrument control for UCLES and UHRF to more modern control computers has also proceeded steadily, as described in more detail in the following section.

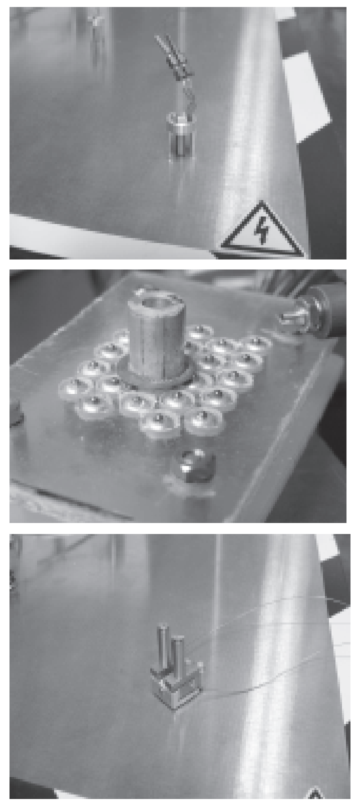
Image showing the stars, glowing gas, and dust in the Galactic star formation region known as G15.03-0.68, observed at a wavelength of 2.2 microns with IRIS2's new science-grade array. Image courtesy of Steven Longmore, UNSW.

Instrument Science

2005-06 has been a successful year for the Instrument Science group. The AAO was awarded a $1.6M research grant from PPARC to develop photonic OH suppression technology over the next three years. The group has developed several new concepts, including the AAOmicron IR wide-field spectrograph, Bragg gratings in few-mode fibres, an integrated photonic spectrograph, and super-starbugs for moving objects with a mass of order 1 kg. The group has also proposed the development of smart telescope structures in addition to smart focal planes as part of the push to develop an extremely large telescope (ELT).

In staff movements, Anthony Horton has joined the group from the Institute for Astronomy, Cambridge. He has expertise in optical design and systems software. Horton will play a key role in the Telescope Control System (TCS) project and will be active in new developments in astrophotonics. Peter Gillingham emerged from retirement to assist the group on key projects. PhD student Jackie Marcel completed her thesis on astrophotonics, and moves on to a research program at the University of Wisconsin, USA.

The Instrument Science group continues to be heavily involved in internal and external projects. The AAOmega project has been a spectacular success, in large part because of Will Saunders' technical oversight and unique abilities in commissioning instruments. Andrew McGrath has played a key role in both the FMOS and WFMOS projects, with FMOS now close to being shipped to the Subaru telescope. In collaboration with the University of Durham, Roger Haynes has now completed his two-year exploration of new photonic components, a project funded by an Innovative Technologies grant from PPARC. In collaboration with another staff member Simon Ellis, he championed the concept of the AAOmicron IR wide-field spectrograph, which builds on the existing AAOmega instrument. Horton and Saunders played a key role in the optical design of the Australian Patrol Telescope (APT) for the University of New South Wales.



Starbugs - microrobotic actuators - provide a precise, fast and flexible method of positioning multiple payloads in the focal plane of telescopes, to pick out small objects or regions of interest. Shown here are three prototype actuators developed at the AAO. Photos Jurek Brzeski

Work on the PPARC-funded 3-year research project has now started. This work has now ramped up with well defined milestones that need to be achieved ahead of a stage-gate review in early 2007. The project will fund Simon Ellis as the new instrument scientist who will develop the systems model for the OH suppression instrument concept. Anthony Horton and Roger Haynes are charged with designing the prototype OH suppression spectrograph that could ultimately be funded by either ESO or Gemini. Early successes include a high-throughput multi-mode fibre taper being developed with the University of Bath. Moreover, we have printed a Fibre Bragg Grating (FBG) into a few-mode fibre and demonstrated that the individual modes separate cleanly. Theoretical work has begun to define how the 75nm band gratings will be broadened by a factor of 4 to cover the full H and J bands.

AAO staff John Dawson, Vladimir Churilov and Greg Smith, assembling AAOmega. Photo David Smyth

Several of the group members made important representations at the SPIE meeting held in Orlando, Florida in May 2006. In a new development, Joss Bland-Hawthorn has described for the first time an integrated photonic spectrograph, a concept that caused a lot of excitement at the SPIE meeting. Horton presented new work on light coupling into few-mode fibres in anticipation of printing FBGs into these later in the year. Haynes presented results on new photonic components arising from the PPARC-funded astrophotonics work.

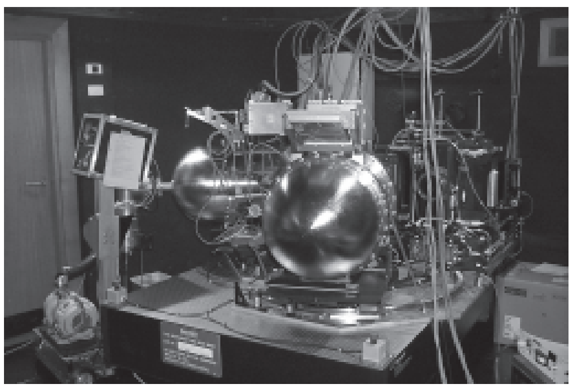
Earlier in the year, the AAO completed its Opticon FP6 commitment to developing a Starbug prototype, a quasi-autonomous robot that would form the basis of a "smart focal plane" positioning system. Ongoing work is currently unfunded, although the group has submitted a major proposal for PPARC funding. The group is currently engaged in defining the AAO's future role in a multinational submission by the European Community for future funding under Opticon FP7.

Finally, the Instrument Science group has been invited to join the CUDOS consortium based at the University of Sydney. A major submission has been made to the ARC in support of this. The AAO, under CUDOS, will investigate the potential of photonic gratings and mechanisms for use at mid-infrared wavelengths. The invitation by CUDOS is an endorsement by the photonics community of the AAO's leading role in developing the field of astrophotonics.

Current Instrumentation

AAOmega

The AAOmega project (http://www.aao.gov.au/AAO/2df/aaomega/aaomega_intro.html) is designed to replace the two 2dF top end mounted fibre-fed spectrographs with a new coude 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 more detailed observation. The instrument was successfully commissioned on the AAT at the end of calendar year 2005.



Top: AAOmega installed in the Coude West room at the AAT. Left: Detail of the SPIRAL IFU. Photos Chris McCowage.

As well as the feeds from the 2dF field plates, AAOmega will also support integral field observations with a refurbished SPIRAL Integral Field Unit (IFU). The SPIRAL system will be available with any AAOmega grating configuration, and will give 50% higher spectral resolution because of its smaller fibres. Commissioning of the SPIRAL mode began in June 2006.

Telescope Control System (TCS)

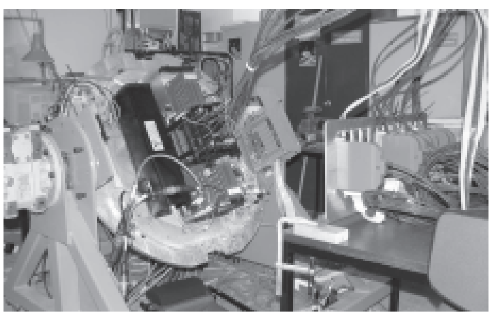
The telescope control system project is to implement a replacement of the original Interdata computer system. Although the current system is very reliable, the Interdata computer is obsolete and replacement parts are very difficult to find. The new system will implement a modern computer platform, but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

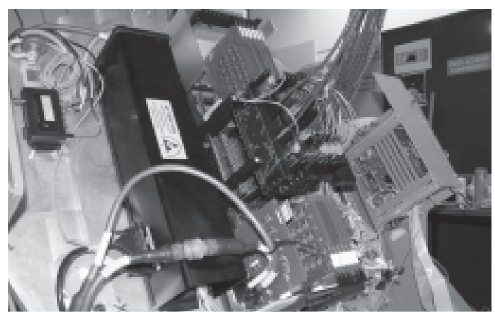
A related project is also underway to replace the old instrument control systems and will be finished in late 2006.

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:

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





FMOS Echidna during 60 degree Zenith calibration tests. Photos Jurek Brzeski

FMOS Echidna

Echidna is a 400 optical fibre robotic positioning system for the Japanese Subaru telescope in Hawaii and is part of the FMOS system (http://www.naoj.org/staff/akiyama/FMOS/) 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. Delays have resulted due to late shipment of components from an overseas vendor. Delivery to Subaru should take place towards the end of 2006 with commissioning on the telescope by the middle of 2007.

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 B" work package in which three prototype concepts were evaluated. Effort is now focused towards securing a PPARC grant and future FP7 funding for continued development.

WFMOS

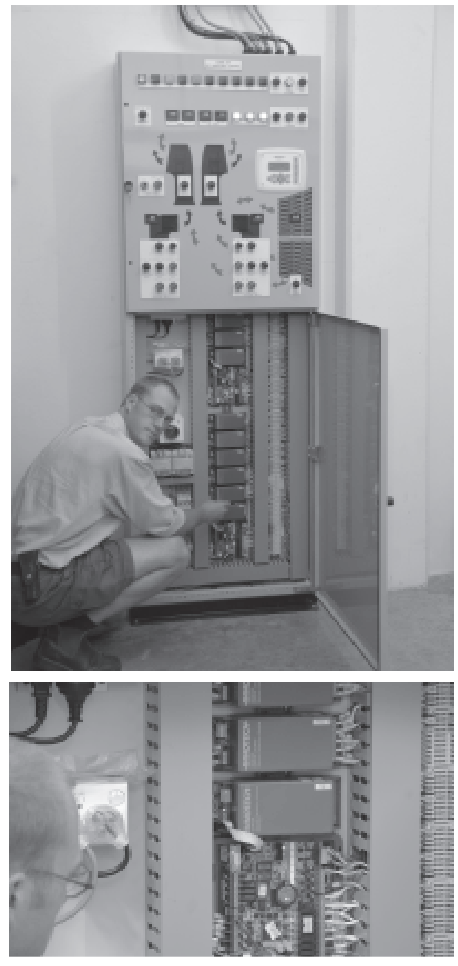
The AAO led a collaboration of 7 institutions (including NOAO, Johns Hopkins University, University of Portsmouth, University of Oxford, University of Durham, and the Rutherford Appleton Laboratories) to develop a concept design for a very wide field (1.5 degree), highly multiplexed (4500 fibers) multi-object spectrograph for the Gemini observatory. The concept builds upon the Echidna technology. Due to funding shortfalls in the commissioning Gemini consortium, the study was halted in May 2006.

APT CCD

The AAO has designed and is building a CCD camera for the University of NSW for implementation on its Automated Patrol Telescope located at Siding Spring. Commissioning of the instrument will take place in late 2006.

SONG

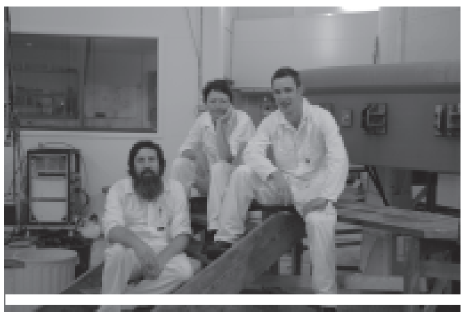
The AAO has been developing the optical design for a high-resolution spectrograph to be used in the Stellar Oscillations Network Group (SONG), which is being developed in Denmark. Details of the SONG project can be found at http://astro.phys.au.dk/SONG/.



John Collins of the AAT's Electronics Section working on the air handling control system of the AAT Dome air conditioning. Photos Jonathan Pogson

Resources

Human Resources



Top: John Danson (ADFA) and Kristin Fiegert viewed through a port in the lid of the AAT aluminising tank. Centre: Steve Lee, Head of Night Assistants, Kristin Fiegert , Optical Technician and ADFA Engineering Work Experience student John Danson, during the aluminising of the AAT primary mirror. Photos Jonathan Pogson. Below: Will Saunders and Greg Smith during the commissioning of AAOmega. Photo David Correll

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, computing, administrative and library staff. Staff members are located at the Epping Laboratory and at the Siding Spring Observatory. Table 4.4 shows staff numbers by tenure.

Table 4.4 Staff Numbers by Tenure at 30 June 2006

Fixed Term Positions	Number of Full Time	Number of Part-Time	TOTAL FTE#
Director*	1	-	1.0
Instrument Scientist	1	-	1.0
Instrumentation	1	1	1.5
Research Astronomer	6	1	6.5
Operations	3	-	3.0
Corporate/Information Technology	1	1	1.8
Sub total	13	3	14.8
Indefinite Term Positions	**Number of Full Time**	**Number of Part-Time**	**TOTAL FTE#**
Executive Officer	1	-	1.0
Instrument Scientist	3	1	3.8
Instrumentation	18	1	18.8
Research Astronomer	1	-	1.0
Operations	13	3	14.5
Corporate/Information Technology	8	3	9.7
Sub total	44	8	48.8
Total Staff	**57**	**11**	**63.6**

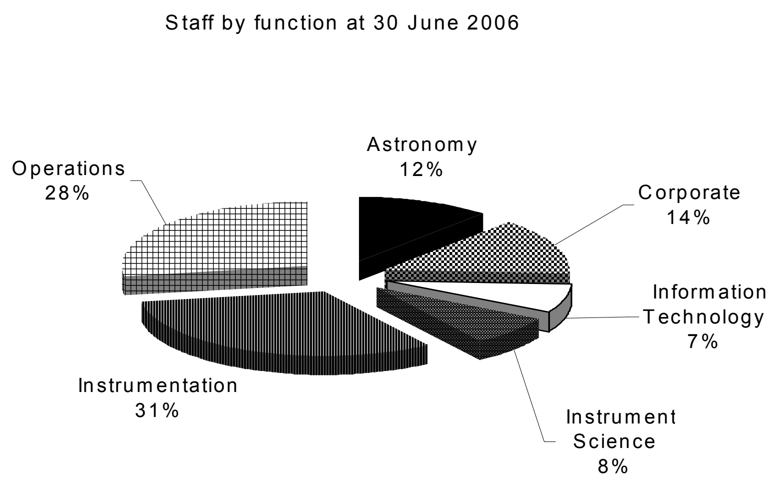
*direct Board appointment; # full time equivalent

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 accounting, library and other support services.
- Information technology which manages systems at both sites.

Figure 4.13 shows staff by function



Employment arrangements

The AAO's terms and conditions of employment are set via a certified agreement, the Anglo-Australian Telescope Board Enterprise Agreement 2005-2007, and the Anglo-Australian Telescope Board (Salaries and Conditions) Award 1999.

Equal Employment Opportunity (EEO)

The AAT Board is an equal employment opportunity employer and strongly supports workplace diversity. The chart overleaf shows the ratio of males to females at the AAO and reflects the difficulty of attracting and retaining females in science.

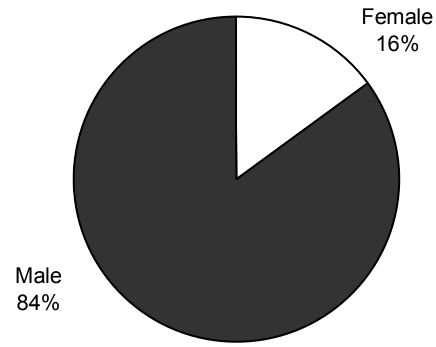


Figure 4.14 shows the relative numbers of male and female staff at the AAO

During the year the AAO also had 16 visiting students. Of this number 13% were female.

Occupational health and safety

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 foci for the year on emergency and evacuation policy and procedures, safe handling of chemicals, and the use of laser equipment.

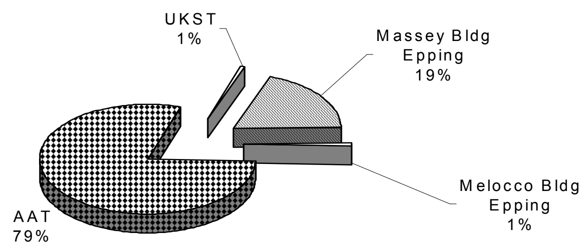
The AAT Board's Workers Compensation insurer is Comcare - an Australian Government statutory authority responsible for workplace safety, rehabilitation and compensation. The AAO has worked hard to maintain a safe working environment. There have been no notifications of dangerous occurrences for the last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

Table 4.5 OH&S Statistics

	2001-02	2002-03	2003-04	2004-05	2005-06
No of claims	1	5	2	2	3
Payments made	$75	$12,400	$2,735	$3,241	$15,121
Dangerous occurrences	0	0	0	0	0
Workers Compensation premiums	$16,926	$15,612	$32,500	$37,309	$35,120

In 2005, the AATB 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.

Figure 4.15 shows infrastructure upgrades by cost and location

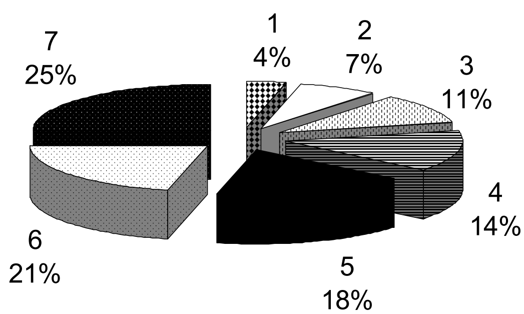


Following an approach by the AATB, the Australian and United Kingdom Governments provided $2.7 million to fund a remedial works program. This program has commenced and is expected to be completed over a 2-3 year timeframe. The AAO Safety Committees will be actively involved in the project.

The tasks identified for remedial work have been grouped into 7 sections reflecting the variety of works and the likely trades involved.

1. Asbestos identification and rectification
2. Buildings
3. Domes
4. Electrical
5. Fire
6. Heights & Handling
7. General

Figure 4.16 shows these task sections and the estimated costs



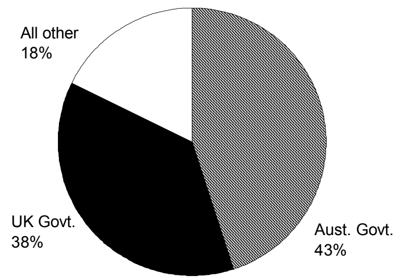
Financial Resources

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 AAT Board and has again provided a clear audit certificate. The auditor's report is also contained in Appendix A.

Funding sources for the AAO are:

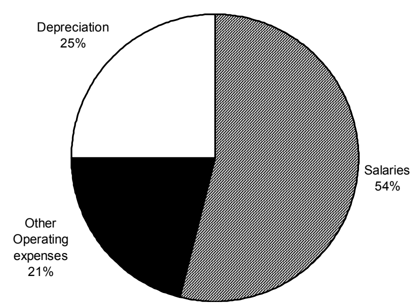
- Government grants provided by Australia and the United Kingdom.
- Contracts for the building of instruments for external clients.
- Other revenue which includes research grants, fellowships funded via the ARC and PPARC, and the RAVE international consortium for survey work on the UKST. This year PPARC has funded a major research project in the area of OH Suppression (see page 44).

Figure 4.17 Sources of funds for 2005-06



The AAT Board is funded mostly for recurrent expenditure and has to strike a balance between that expenditure, capital needs and telescope 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 of the UK is not.

Figure 4.18 Application of expenses for 2005-06



The results for 2005-06 show that the AAT Board has net assets of $46.8 million and both revenue and expenses increased by about 11% over the previous year. The AAT Board focus for the year has been both 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.

The Australian astronomy community has included the AAO, as a priority, in its funding bid to the Australian Government's National Collaborative Research Infrastructure Strategy (NCRIS). This funding bid has arisen as the community seeks to fund its Decadal Plan 2006-2015. The Board is also attempting to increase its external revenue through its instrumentation program, both domestically and overseas. The Board expects to be able to fund an expenditure program of $11.2m for 2006/07.

Business Systems

Major instrumentation projects demand that the contractors have systems that are adequate to facilitate a high level of project performance, management and control. The AAO, as a contractor, has outgrown the capability of its business systems to meet such expectations for major projects. During the year, the AAO has sought new business software and investigated several packages. The preference was for:

- a fully integrated solution which will allow time recording, project management, project scheduling (i.e. integration with MS Project), project and general accounting, and general ledger functions.
- a smaller business-type solution with a low total cost of ownership.

The AAO has purchased MS Dynamics which includes time and expense management, billing, revenue recognition, cost allocations, contract management, employee and resource utilization, project profitability analysis and sophisticated reporting tools.

The implementation of this new software is one of the AAO's major tasks of 2006-07 and the aim is to have the new system running early in 2007. This implementation will more than satisfy the requirements of managing large projects.

Information Technology

The implementation of the IT Strategic plan is proceeding as planned. Funding of the plan's implementation is being drawn from the normal recurrent expenditure for Information Technology. Good progress has been made with the modernisation of the Observatory's computing infrastructure, and this program will be continuing over the next two years. Of significant note is the recent implementation of a high-speed Internet connection to Siding Spring. This new connection is performing well, and provides many opportunities for the future.

The focus of the IT team over the coming year will be the new project management and financial software, implementation of the new Telescope Control System for the AAT, continuation of the program to replace legacy systems and the upgrading of Network Infrastructure to ensure we can get the most from the new high-speed network link.

Environmental Performance

Dark-sky Protection

The Anglo-Australian Observatory continues to participate in activities designed to protect the dark sky of Siding Spring Observatory. The inter-organisational Working Group that develops and implements strategies to this end is now chaired by Mr Peter Starr (ANU Siding Spring Observatory Manager), with AAO representation coming from Dr Fred Watson (Astronomer-in-Charge) and Mr Paul Cass (UKST Observer). 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 new Orana Regional Environmental Plan (REP), which addresses the issue of upward light spill over a large area of the state with a radius of 200 km centred on Siding Spring, is now in the final stages of ratification by the NSW Department of Planning. It will be placed on public display late in 2006 and is expected to be enacted early in 2007.

Ongoing challenges to the dark skies of Siding Spring remain the community of Coonabarabran (with growing ribbon development along the Timor Road leading to the observatory) and the cities of Dubbo and Sydney.

View of the UK Schmidt Telescope and across Warrumbungle National Park. Photo Jonathan Pogson

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 committee. 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 and continues to attract a large audience. Most of the Internet visitors are attracted by the images pages, which now support a total of about 220 photographs.

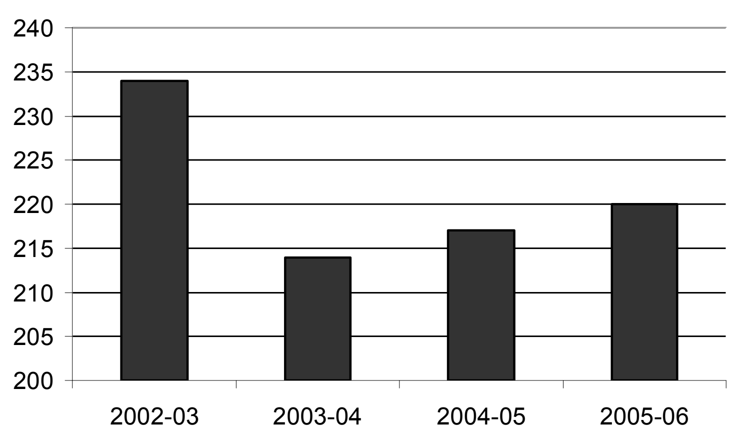
A newsletter is published twice a year on the web, and distributed as a hardcopy, to over 1,000 subscribers and institutions. It caters to a wide range of readers, including professional astronomers, instrument scientists, users of the observatory and local AAO staff.

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

Figure 4.19 Media Interviews



The AAO issued four media releases this year. AAO staff gave 220 media interviews (mainly radio) and wrote ten popular science articles; they gave 48 talks to audiences of lay-people and 79 talks to audiences of professional astronomers. The AAO organised the annual Bok lecture and a session of “Science in the Pub”—now becoming an annual tradition also—at Coonabarabran in October as part of the local “Festival of the Stars”, with the latter session attracting a standing-room-only crowd.

The panel for the 2005 session of “Science in the Pub” at the Coonabarabran Festival of the Stars. Left to right: Professor Fred Watson (AAO), Dr Maria Cunningham (UNSW), Ms Jen Lacey (ABC), and Associate Professor David McKinnon (Charles Sturt University). The topic was “Extraterrestrials: where are they?” Photo Helen Sim

In July 2005, “Discovery Communications” filmed a segment of its most ambitious project to date at the AAO’s telescopes on Siding Spring Mountain. Over the next five years this narrative will focus on the cultures, geography and natural phenomena of 30 of the worlds oldest and most diverse countries. The program for which Fred

Caption: AAT Astronomer-in-Charge, Fred Watson, being filmed for a Discovery Channel program, "Australia Revealed" in the AAT tea room. Photo Chris Thorburn, Beyond International Ltd.

Watson was filmed will go to air on Discovery Channel in most countries on October 22, 2006, and one week later on October 29 in Australia and New Zealand.

Professor Fred Watson was awarded the 2006 Australian Government Eureka Prize for Promoting Understanding of Science, and received the award in August in front of a crowd of more than 900 representatives of government, science, industry, academia and the media. The Eureka Prizes are a partnership between the Australian and NSW governments and more than 20 organizations, and the Eureka Prizes awards night is the largest single annual event in Australia for celebrating and rewarding outstanding science and science communication. The Eureka Prize for Promoting Understanding of Science is given for effort and initiatives in science outreach that go beyond the usual or expected scope and activities of an entrant's profession or occupation. Supporting statements for the award spoke of Fred's "passion and tireless enthusiasm" for his subject. One described his effect thus:

Listening to scientists talk can occasionally leave the lay-person feeling stupid and ill-informed; as if the subject at hand will always be beyond us. When Fred is talking, he seems to have the opposite effect: the mists clear and a whole world of knowledge suddenly seems accessible.

— Richard Glover, ABC

The Hon. Julie Bishop MP, Minister for Education, Science and Training. with Fred Watson, winner of the Eureka Prize for Promoting Understanding of Science Photo © Australian Museum

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 2006 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 2006 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.

Chair of the Board 28 September 2006	Deputy Chair of the Board 28 September 2006

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 the Anglo-Australian Telescope Board for the year ended 30 June 2006. The Directors 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 Anglo-Australian Telescope Board's annual report.

Scope

The financial statements and Directors' responsibilities

The financial statements comprise:

- Statement by the Members of the Board;
- Income Statement, Balance Sheet and Statement of Cash Flows;
- Statement of Changes in Equity;
- Schedules of Commitments and Contingencies; and
- Notes to and forming part of the Financial Statements

of the Anglo-Australian Telescope Board for the year ended 30 June 2006.

The Directors are responsible for preparing the financial statements that give a true and fair view of the financial position and performance of the Anglo-Australian Telescope Board and that comply with Finance Minister's Orders made under the *Commonwealth Authorities and Companies Act 1997,* Accounting Standards and mandatory financial reporting requirements in Australia. The Directors 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

We have conducted an independent audit of the financial statements to express an opinion on them to you. Our audit has been conducted in accordance with the Australian National Audit Office Auditing Standards, which incorporate the Australian Auditing and Assurance Standards, to provide reasonable assurance as to whether the financial statements are free of material misstatement. The

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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.

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.

We 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 our understanding of the Anglo-Australian Telescope Board's financial position, and of its financial performance and cash flows.

The audit opinion is based on 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, we have followed the independence requirements of the Australian National Audit Office, which incorporate the ethical requirements of the Australian accounting profession.

Audit Opinion

In my opinion, the financial statements of the Anglo-Australian Telescope Board:

(a) have been prepared in accordance with Finance Minister's Orders made under the *Commonwealth Authorities and Companies Act 1997;* and
(b) give a true and fair view of the Anglo-Australian Telescope Board's financial position as at 30 June 2006 and of its performance and cash flows for the year then ended, in accordance with:
   (i) the matters required by the Finance Minister's Orders; and
   (ii) applicable Accounting Standards and other mandatory financial reporting requirements in Australia.

Australian National Audit Office

P Hinchey
Senior Director
Delegate of the Auditor-General

Sydney
29 September 2006

ANGLO-AUSTRALIAN TELESCOPE BOARD
Income Statement
for the year ended 30 June 2006

	Notes	2006 $'000	2005 $'000
Revenue			
Revenue from Australian government	1.4	**4,688**	4,112
Revenue from UK Government	1.4	**3,700**	3,700
Goods and services	4A	**1,775**	1,462
Other	4B	**424**	358
Interest	-	**124**	53
Total revenue		**10,711**	9,685
Gains			
Net Gains from disposal of assets	4C	**37**	**-**
TOTAL GAINS		**37**	-
Total income		**10,748**	9,685
Expenses			
Employees	5A	**6,227**	5,414
Suppliers	5B	**2,404**	2,156
Depreciation	5C	**2,812**	2,767
Other expenses		**-**	3
Total Expenses		**11,443**	10,340
Operating result		**(695)**	(655)

ANGLO-AUSTRALIAN TELESCOPE BOARD
BALANCE SHEET
as at 30 June 2006

	Notes	2,006	2,005
ASSETS		**$'000**	$'000
Financial assets			
Cash and cash equivalents	6A	**3,635**	356
Receivables	6B	**315**	277
Total financial assets		**3,950**	633
Non-Financial assets			
Land and buildings	7A	**22,404**	23,608
Infrastructure, plant and equipment	7B	**26,085**	25,984
Other non-financial assets	7D	**58**	65
Total non-financial assets		48,547	49,657
TOTAL ASSETS		52,497	50,290
LIABILITIES			
Payables			
Suppliers	9A	**525**	37
Other Payables	9B	**2,878**	998
Total payables		**3,403**	1,035
Provisions			
Employee Provisions	8A	**2,324**	1,790
TOTAL LIABILITIES		5,727	2,825
NET ASSETS		**46,770**	47,465
EQUITY			
Reserves		**40,303**	40,303
Retained Surpluses		**6,467**	7,162
TOTAL EQUITY		**46,770**	47,465
Current assets		**4,008**	698
Non-current assets	**7C**	**48,489**	49,592
Current liabilities		**4,642**	1,741
Non-current liabilities		**1,084**	1,084

ANGLO-AUSTRALIAN TELESCOPE BOARD
STATEMENT OF CASH FLOWS
for the year ended 30 June 2006

	Notes	2006	2005
OPERATING ACTIVITIES		**$'000**	$'000
Cash received			
Goods and services		**1,687**	2,354
Contribution - Australian Government	6A	**6,640**	3,084
Contribution - UK Government	6A	**3,475**	3,700
Interest		**124**	53
Other		**350**	322
Total cash received		**12,276**	9,513
Cash Used			
Employees		**5,720**	5,644
Suppliers		**1,605**	2,198
Total cash used		**7,325**	7,842
Net cash from operating activities	10	**4,951**	1,671
INVESTING ACTIVITIES			
Cash received			
Proceeds from sale of land & buildings		**125**	-
Total cash received		**125**	-
Cash used			
Purchase of property, plant and equipment		**1,797**	2,311
Total cash used		**1,797**	2,311
Net cash from or (used by) investing activities		**(1,672)**	(2,311)
Net increase (decrease) in cash held		**3,279**	(-640)
Cash at beginning of reporting period		**356**	996
Cash at end of reporting period	6A, 10	**3,635**	356

STATEMENT of CHANGES IN EQUITY
for the year ended 30 June 2006

	Accumulated Result		Asset Revaluation Reserve		Total Equity	
	2006	2005	**2006**	2005	**2006**	2005
	$'000	$'000	**$'000**	$'000	**$'000**	$'000
Opening Balance	**7,162**	7,817	**40,303**	35,975	**47,465**	43,792
Income and Expense						
Revaluation Adjustment			**-**	4,328	**-**	4,328
Net Operating result	**(695)**	(655)			**(695)**	(655)
Closing balance at 30 June	**6,467**	7,162	**40,303**	40,303	**46,770**	47,465

ANGLO-AUSTRALIAN TELESCOPE BOARD
SCHEDULE OF COMMITMENTS
for the year ended 30 June 2006

	2006 $'000	2005 $'000
By Type and Maturity		
Operating Leases[1]		
One year or less	**43**	61
From one to two years	**66**	11
Total Commitments	**109**	72

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

SCHEDULE OF CONTINGENCIES
as at 30 June 2006

The AAT Board did not acknowledge any reportable contingent liabilities or assets

ANGLO-AUSTRALIAN TELESCOPE BOARD
NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS
for the year ended 30 June 2006

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 (or FMOs, being the *Financial Management and Accountability Orders (Financial Statements for reporting periods ending on or after 01 July 2005)*);
- Australian Accounting Standards issued by the Australian Accounting Standards Board (AASB) that apply for the reporting period; and
- Interpretations issued by the AASB and Urgent Issues Group (UIG) that apply for the reporting period.

This is the first financial report to be prepared under Australian Equivalents to International Financial Reporting Standards (AEIFRS). The impact of adopting AEIFRS is disclosed in Note 2.

The Income Statement, Balance Sheet and Statement of Changes in Equity have been prepared on an accrual basis and are in accordance with the historical cost convention, except for certain assets and liabilities which as noted, are at fair value. Except where stated, no allowance is made for the effect of changing prices on the results or the financial position.

The financial report is presented in Australian dollars and values are rounded to the nearest thousand dollars unless disclosure of the full amount is specifically required.

Unless alternative treatment is specifically required by an accounting standard, assets and liabilities are recognised in the Balance Sheet when and only when it is probable that future economic benefits will flow and the amounts of the assets or liabilities can be reliably measured. However, assets and liabilities arising under agreements equally proportionately unperformed are 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.

Unless alternative treatment is specifically required by an accounting standard, revenues and expenses are recognised in the Income Statement when and only when the flow or consumption or loss of economic benefits has occurred and can be reliably measured.

1.2 Significant Accounting Judgments and Estimates

In the process of applying the accounting policies listed in this note, the Anglo-Australian Telescope Board (AAT Board) has made the following judgement:

- The fair value of land and buildings has been taken to be the market value of similar properties as determined by an independent valuer. In some instances, Anglo-Australian Observatory buildings are purpose-built and may in fact realise more or less in the market.

No accounting assumptions or estimates have been identified that have a significant risk of causing a material adjustment to carrying amounts of assets and liabilities within the next accounting period.

1.3 Statement of Compliance

The financial report complies with Australian Accounting Standards, which include Australian Equivalents to International Financial Reporting Standards (AEIFRS). The AASB has issued amendments to existing standards which are not effective at the reporting date. The AAT Board intends to adopt all standards upon their application date. As at the reporting date, there is no expected effect from application of these standards.

1.4 Revenue

The Governments of Australia and the United Kingdom provide most of the AAT Board's revenue. 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). Contributions receivable from the Governments are recognised at their nominal amounts.

The AAT Board also builds astronomical instrumentation for other observatories and attempts to recover the full economic cost of so doing.

Revenue from rendering of services is recognised by reference to the stage of completion of contracts at the reporting date. The revenue is recognised when:

- The amount of revenue, stage of completion and transaction costs incurred can be reliably measured; and
- The probable economic benefits with the transaction will flow to the entity.

The stage of completion of contracts at the reporting date is determined by reference to the proportion that costs incurred to date bear to the estimated total costs of the transaction.

Receivables for goods and services, which have 30-day terms, are recognised at the nominal amounts due less any provision for bad and doubtful debts. Collectability of debts is reviewed at balance date. Provisions are made when collectability of the debt is no longer probable.

Interest revenue is recognised using the effective interest method as set out in AASB 139.

Grants received from the Australian Research Council (ARC) and PPARC 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 and without a reliable fair value estimate being made*:*

(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 AAT Board's buildings are on the site of the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The AAT 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 AAT 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.

1.5 Employee Benefits

(a) Benefits

As required by the Finance Minister's Orders, the AAT Board has "early adopted" AASB 119 Employee Benefits as issued in December 2004. Liabilities for services rendered by employees are recognised at the reporting date to the extent that they have not been settled.

Liabilities for 'short-term employee benefits' (as defined in AASB 119) and termination benefits due within twelve months are 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 Authority 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 Authority's employer superannuation contribution rates to the extent that the leave is likely to be taken during service rather than paid out on termination.

The estimate of the present value of the liability takes into account attrition rates and pay increases through promotion and inflation.

(c) Superannuation

Staff of the AAT Board are members of the Commonwealth Superannuation Scheme (CSS), the Public Sector Superannuation Scheme (PSS) or the PSS accumulation plan (PSSap). The CSS and PSS are defined benefit schemes for the Commonwealth. The PSSap is a defined contribution scheme. The liability for defined benefits is recognised in the financial statements of the Australian Government and is settled by the Australian Government in due course. The AAT Board makes employer contributions to the Australian Government at rates determined by an actuary to be sufficient to meet the cost to the Government of the superannuation entitlements of the Authority's employees. From 1 July 2005, new employees are eligible to join the PSSap scheme.

The liability for superannuation recognised as at 30 June represents outstanding contributions for the final fortnight of the year.

1.6 Leases

A distinction is made between finance leases and operating leases. Finance leases effectively transfer from the lessor to the lessee substantially all the risks and rewards incidental to ownership of leased non-current assets. An operating lease is a lease that is not a finance lease. In operating leases, the lessor effectively retains substantially all such risks and benefits. The AAT Board has no finance leases.

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

1.7 Cash

Cash means notes and coins held and any deposits held at call with a bank or financial institution. Cash is recognised at its nominal amount.

1.8 Financial Risk Management

The AAT Board's activities expose it to normal commercial financial risk. As a result of the nature of its business and internal and Australian Government policies dealing with the management of financial risk, the AAT Board's exposure to market, credit, liquidity and cash flow and fair value interest rate risk is considered to be low. The Board's workers' compensation cover is provided through Comcare Australia. As the Board is not eligible to belong to Comcover, all of its other insurance cover is with commercial providers.

1.9 Trade Creditors

Trade 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 or services have been received (and irrespective of having been invoiced).

1.10 Acquisition of Assets

Assets are recorded at cost on acquisition except as stated below. The cost of acquisition includes the fair value of assets transferred in exchange and liabilities undertaken. Financial assets are initially measured at their fair value plus transaction costs where appropriate.

Assets acquired at no cost, or for nominal consideration, are initially recognised as assets and revenues at their fair value at the date of acquisition unless acquired as a consequence of restructuring of administrative arrangements. In the latter case, assets are initially recognised as contributions by owners at the amounts at which they were recognised in the transferor authority's accounts immediately prior to the restructuring.

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

Asset Recognition Threshold

Purchases of property, plant and equipment are recognised initially at cost in the Balance Sheet, except for purchases costing less than $3,000, which are expensed in the year of acquisition (other than where they form part of a group of similar items which are significant in total).

Revaluations

(i) Basis

Land, buildings, plant and equipment are carried at fair value, being revalued with sufficient frequency such that the carrying amount of each asset is not materially different, at reporting date, from its fair value. Valuations undertaken in each year are as at 30 June.

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 2006, the AAT Board held no surplus assets. (30 June 2005: $0)

(ii) Frequency

Following initial recognition at cost, valuations are conducted with sufficient frequency to ensure that the carrying amounts of assets do approximate the assets' fair values as at the reporting date. The regularity of independent valuations depends upon the volatility of movements in market values for the relevant assets.

(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 off 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 are used when applying rates to each class of depreciable assets as follows:

Asset class	***2006***	***2005***
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.

1.12 Taxation

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

1.13 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.

1.14 Agreements

Under an agreement between the AAT 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 1.4 relating to use of land.

Note 2. The impact of the transition to AEIFRS from previous AGAAP

There has been no impact on the AAT Board arising from adopting AEIFRS.

Note 3. Economic Dependency

The Board was established by the *Anglo-Australian Telescope Agreement Act* 1970 and operates as the Anglo-Australian Observatory (AAO). It 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' which has been signed by the two Governments. Legislation and diplomatic processes are now completed and the treaty amendment is in effect.

The phased withdrawal of the UK funding does provide the AAT Board with some challenges. The Board intends maintaining operations at the AAT at their current level. The Australian astronomy community has included, as a priority, the AAO in its funding bid to the Australian Government's National Collaborative Research Infrastructure Strategy (NCRIS). This funding bid has arisen as the community seeks to fund its Decadal Plan. The Board is also attempting to increase its external revenue through its instrumentation program (based at its Sydney headquarters) and through access to the UK funding agency's competitive grants program.

Note 4 **Operating Revenues**	**2006**	**2005**
	$'000	**$'000**
4A Sales of goods & services		
Goods - external entities	**748**	855
Services - external entities	**1,028**	607
Total sales of goods and services	**1,775**	1,462
Cost of sales of goods	**568**	665
4B Other revenue		
Grants revenue (fellowships)	**397**	287
Other	**27**	73
Total other revenue	**424**	360

4C Net gains from disposal of assets

A residential property owned by the AAT Board located in the town of Coonabarabran was sold in July 2005 by private treaty to an unrelated third party

Note 5. **Operating Expenses**	**2005 $'000**	**2006 $'000**
5A Employees		
Salaries and wages	**4,801**	4,117
Superannuation	**867**	810
Leave and other entitlements	**479**	421
Other employee benefits	**46**	30
Total employee benefits expenses	**6,193**	5,378
Workers' compensation expenses	**34**	36
Total employee expenses	**6,227**	5,414

5B Suppliers

Goods from external entities	**455**	326
Services from external entities	**1,749**	1,425
Motor vehicle lease costs	**97**	102
Supply of goods and services: external projects	**103**	303
Total suppliers expenses	**2,404**	2,156

5C Depreciation and amortisation

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	**1,029**	1,017
Telescopes	**789**	789
Instruments	**666**	666
Plant & Equipment	**328**	295
	2,812	2,767

Note 6 Financial assets

6A Cash

	2006 $'000	2005 $'000
The Cash at bank and on hand for 2006 reflectsfunding received for an Occupational Health & SafetyRemedial Works program	**3,635**	356

6B Receivables

	2006 $'000	2005 $'000
Goods & Services	**287**	181
Other receivables	**-**	18
GST receivable	**28**	78
Total	**315**	277

Receivables for Goods & Services (Gross) are aged as follows

	2006 $'000	2005 $'000
Not Overdue	**121**	227
Overdue by:		
Less than 30 days	**-**	-
30-60 days	**88**	-
More than 60 days	**78**	50
Total Receivable (Gross)	**287**	277

Credit Terms are Net 30 days (2005 30 days)

Note 7: Non-Financial assets

Note 7A Land and Buildings

	2006 $'000	2005 $'000
Freehold Land - at valuation	**2,950**	2,968
Buildings on Freehold - at valuation	**55,897**	55,965
Less accumulated depreciation	**(36,443)**	(35,325)
	19,454	20,640
Total land and buildings	**22,404**	23,608

ANGLO-AUSTRALIAN TELESCOPE BOARD
NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS
for the year ended 30 June 2006

Note 7B Plant and Equipment

	2006 $'000	2005 $'000
Telescope and ancillary - at valuation	**39,894**	39,457
Less accumulated depreciation	**(25,393)**	(24,605)
	14,501	14,852
Telescope Instrumentation - at valuation	**19,559**	18,360
Less accumulated depreciation	**(9,331)**	(8,665)
	10,228	9,695
Other Plant and Equipment - at valuation	**3,804**	3,646
Less accumulated depreciation	**(2,448)**	(2,209)
	1,356	1,437
Total Infrastructure, Plant & Equipment (non-current)	**26,085**	25,984

Note 7C

TABLE A - Reconciliation of the opening and closing balances of Property, Infrastructure, Plant & Equipment

Item	**Land**	**Buildings**	**Infrastructure Plant & Equipment**	**Total**
as at 1 July 2005	**$'000**	**$'000**	**$'000**	**$'000**
Gross book value	2,968	55,965	61,462	120,395
Less: Accumulated depreciation as at 30 June 2005	0	35,325	35,478	70,803
Opening net book value	2,968	20,640	25,984	49,592
Additions	-	22	1,871	1,893
Disposals	18	90	76	184
Depreciation	-	1,118	1,694	2,812
as at 30 June 2006				
Gross book value	2,950	55,897	63,257	122,104
Less: Accumulated depreciation/ amortisation	0	36,443	37,172	73,615
Closing net book value	**2,950**	**19,454**	**26,085**	**48,489**

Note 7C. TABLE B - Assets at valuation

Item	Land	Buildings	Telescope	Instruments	Plant & Equipment	Total
	$'000	$'000	$'000	$'000	$'000	$'000
As at 30 June 2006						
Gross value	**2,950**	**55,897**	**39,896**	**19,559**	**3,802**	**122,104**
Accumulated depreciation	**-**	**36,443**	**25,394**	**9,331**	**2,447**	**73,615**
Net book value	**2,950**	**19,454**	**14,502**	**10,228**	**1,355**	**48,489**
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

7D Other non-financial assets

	2006	2005
	$'000	$'000
Prepayments for goods and services - includes insurance premiums, rentals in advance and subscriptions; all pre-payments are current	**58**	65

Note 8. Provisions

8A Employee Provisions

	2006 $'000	2005 $'000
Salaries and wages	**58**	25
Leave	**2,265**	1,765
Aggregate employee benefits liability and related costs	**2,324**	1,790
Current	**1,240**	706
Non-current	**1,084**	1,084
Aggregate employee benefits liability and related costs	**2,324**	1,790

Note 9. Payables

9A Suppliers

	2006 $'000	2005 $'000
Trade creditors (current)	**525**	37

9B Other

	2006 $'000	2005 $'000
Non-trade creditors	**2,878**	-
PPARC contribution in advance	**-**	925
National Astronomical Observatory of Japan	**-**	74
Total	**2,878**	999

Note 10. Cash Flow Reconciliation

Reconciliation of operating result per Income Statement to Statement of Cash Flows

	2006 $'000	2005 $'000
Cash at year end per Statement of Cash Flows	**3,635**	356
Statement of Financial Position items comprising above cash:		
"Financial Assets - Cash and cash equivalents"	**3,635**	356

Reconciliation of operating result to net cash from operating activities:

	2006 $'000	2005 $'000
Operating Result (deficit)	**(695)**	(655)
Depreciation and amortisation	**2,812**	2,767
Gain disposal of assets	**(37)**	0
(Increase)/Decrease in receivables	**(38)**	886
(Increase)/Decrease in prepayments	**7**	51
Increase/(decrease))in liabilities to employees	**534**	(15)
Increase/(decrease) in supplier payables	**488**	(36)
Increase/(decrease) in other payables	**1,880**	(1,327)
Net cash from / (used by) operating activities	**4,951**	1,671

Note 11. Related Party Disclosures and Remuneration of Directors

Members of the Board at 30 June 2006 were:

UK - Dr P Roche (Chair), Dr S Warren and Dr C Vincent,
Australia - Professor W Couch (Deputy Chair), Professor B Schmidt* and Mr G Harper
Board members do not receive remuneration.

During the year, the following Board members resigned:

Dr M Irwin, University of Cambridge (December 2005)
Mr G Brooks, Particle Physics and Astronomy Research Council (April 2006)

* Professor 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 at Siding Spring. (See also note 1.4)

ANGLO-AUSTRALIAN TELESCOPE BOARD
NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS
for the year ended 30 June 2006

Note 12. Executive Remuneration

	2006 $'000	2005 $'000
The aggregate amount of remuneration of executives shown is	**1,025**	296

The number of senior executives who received or were due to receive total remuneration of

	2006	2005
$130,000 or more		
$130,000-144,999	**3**	3
$145,000-159,999	**3**	2
$160,000-174,999	**-**	-
$175,000-189,999	**1**	1
Total	**7**	6

Note 13. Remuneration of Auditors

	2006 $	2005 $
Remuneration to the Auditor-General forauditing the financial statements for the reporting period (excluding GST).	**31,000**	28,000

Services were also provided by the Auditor-General during the year validating OPTICON FP6 expenditure.

Note 14. Average Staffing Levels

	2006	2005
The average staffing levels (headcount) for the year were:	**64**	66

Note 15. External Projects

15A 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.

	2006 $'000	2005 $'000
Instalments received	**265**	638
Supplier expenses	**(38)**	(218)
Employee expenses	**(251)**	(267)
Overhead Recovered	**(50)**	(174)
Balance from prior year	**74**	95
Instalments deferred (Other Liabilities)	**225**	74

15B The University of NSW contracted the AAT Board on a project to couple a large format camera (2 (2K X 6K) MIT/LL detectors) and associated filter changer mechanism to the Automated Patrol Telescope located at Siding Spring. Contract completion is expected to be late 2006. The position at 30 June 2006 was:

	2006 **$'000**	2005 $'000
Instalments received	**330**	-
Supplier expenses	**(75)**	-
Employee expenses	**(167)**	-
Overhead Recovered	**(88)**	-
Project Profit(Loss) absorbed by AAO	**-**	-

Note 16. Financial Instruments.

Financial Assets		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	6B	These receivables are recognised at the nominal amount 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
Financial Liabilities		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	Creditors and accruals are recognised at their nominal amounts, being amounts at which the liabilities will be settled. Liabilities are recognised to the extent that the goods or services have been received (and irrespective of having been invoiced)
Other Liabilities	9B	Amounts owing to the National Astronomical Observatory of Japan, representing unspent contributions, are recognised at their nominal amounts.

Note 16A. Interest rate risk

Financial Instrument	Note	Floating Interest Rate		Non-Interest Bearing		**Total**	
		2006	2005	**2006**	2005	**2006**	2005
		$'000	$'000	**$'000**	$'000	**$'000**	$'000
Financial Assets							
Cash at Bank	6A	**3,604**	330	**-**	-	**3,604**	330
Cash on Hand	6A	**-**	-	**31**	26	**31**	26
Receivables	6B	**-**	-	**315**	277	**315**	277
Total Financial Assets		**3,604**	330	**346**	303	**3,950**	633
TOTAL ASSETS						**52,497**	50,290
Financial Liabilities							
Suppliers	9A	**-**	-	**525**	37	**525**	37
Other	9B	**-**	-	**2,878**	998	**2,878**	998
Total Financial Liabilities		**-**	-	**3,403**	1,035	**3,403**	1,035
TOTAL LIABILITIES						**5,727**	2,825

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 short term in nature, are their carrying values as shown.

Note 16B. 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 Balance Sheet. The Board has no significant exposures to any concentration of credit risk.

Appendix B
Staff

Staff at 30 June 2006

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 Horton, PhD; D H Jones, PhD; A J McGrath, PhD; S J O'Toole, 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:	S T Fahey; D Hewawitharana; D R Kingston, CPA; R L Martin; K Powell, BA; L J Reeves; H M Woods, MLitt
Library:	S D Ricketts, BSc
Software Development:	M N Birchall, PhD; T J Farrell, BSc; R Heald, BSc; 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; M M Kanonczuk; U Klauser; A F Lankshear, BSc; S Miziarski, DipME; G A Smith, BE, BSc; D J Stafford; J D Whittard
Telescope Operations & Maintenance:	UKST: 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 2006

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*
(dF Fellow)
Simon Ellis*
(AAO Research Fellow)
Heath Jones
(ARC / Director's Fellow)
Greg Madsen
(NSF/MPS Visiting Fellow)
Simon O'Toole*
(AAPS Research Fellow)

Students *
Kathryn Harris
(UK Summer Student)
Jayne Birkby
(UK Summer Student)
Benjamin Rozitis
(UK Summer Student)

INSTRUMENTATION

Sam Barden

SOFTWARE
Tony Farrell
Keith Shortridge
Ronald Heald
Minh Vuong
Scott Smedley
Michael Birchall*

MECHANICAL/ OPTICAL
John Dawson
Jurek Brzeski
Vladimir Churilov
Stan Miziarski
Greg Smith
Urs Klauser
Denis Whittard

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

PROJECT OFFICE
Chris Evans*
Gabriella Frost

INSTRUMENT SCIENCE

Joss Bland-Hawthorn
Roger Haynes
Anthony Horton*
Andrew McGrath
Will Saunders

Students *
Jackie Marcel
(Sydney PhD to Jul 07; Haynes)

EXECUTIVE OFFICER
Neville Legg

ADMINISTRATION
Devika Hewa
Sue-Ellen Fahey*
Don Kingston
Kathleen Powell
Larry Reeves*

LIBRARY
Sandra Ricketts

Associates
Jeremy Bailey
Peter Gillingham
Russell Cannon
Raylee Stathakis

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

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

AAT NIGHT
Steve Lee
(Shaun James)
(Jonathan Pogson)
(John Stevenson)

UKST OBSERVERS
Fred Watson* (AiC)
Paul Cass*
Malcolm Hartley*
Ken Russell*

Notes
1. Staff with an asterisk * are fixed term.
 . Names in parentheses have primary roles that appear elsewhere in the chart.
3. Staff on the left are at Epping; those on the right are at Siding Spring.

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 roles of Chair and Deputy Chair alternate between the two countries. At 30 June 2006 the Board members and their terms of office were:

United Kingdom

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

Dr Colin Vincent, Head, Astronomy Division, Particle Physics and Astronomy Research Council; appointed 5 April 2006 for an indefinite period

Dr Stephen Warren, Reader, Department of Physics, Imperial College London; appointed 1 March 2006 till 29 February 2008.

Australia

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

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

Professor Brian Schmidt, ARC Federation Fellow, Research School of Astronomy and Astrophysics, Australian National University; appointed 1 January 2005 till 31 December 2006.

During the year, the following Board members resigned:

Dr Mike Irwin, University of Cambridge (December 2005)
Mr Graham Brooks, Particle Physics and Astronomy Research Council (April 2006).

C. Board meeting attendance

The AAT Board met three times in 2005–06.

Board member	No. of meetings attended
Dr P Roche, (Chair)	3/3
Professor W Couch (Deputy Chair)	3/3
Mr G Brooks	2/2
Mr G Harper	3/3
Dr M Irwin	1/1
Dr B Schmidt	3/3
Dr C Vincent	1/1
Dr S Warren	2/2

D. Special responsibilities

Messrs Harper and Vincent 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 Management Committee

The Audit and Risk Management Committee is a subcommittee of the AAT Board 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, Dr Vincent PhD and Mr Harper, FAICD, FCPA and Mr John M. Williams B.Ec, FCPA from the CSIRO, as an independent member.

The committee met twice in 2005–06. Member attendance details are:

Committee member	No. of meetings attended
Mr G Harper (Chair)	2/2
Mr G Brooks*	2/2
Mr J Williams	2/2

* Dr Vincent replaced Mr Brooks in April 2006.

3. Performance Management

The AAO has an active performance management system. 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. Considerable effort 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. AATAC Members

The AATAC Guidelines indicate that when a committee member is included in the list of applicants on a proposal, or otherwise feels they may have a conflict of interest, he/she must excuse themselves from the meeting during discussion and voting on that particular proposal.

5. Ethical standards

All staff are required to observe the AAO Code of Conduct which requires AAO Staff to perform their duties and conduct themselves in a manner which ensures that they maintain a reputation for fair dealing.

Appendix E
Advisory Committees

Time allocation committees

Under Article 5 (1) of the Supplementary Anglo-Australian Telescope Agreement, observing time on the AAT and use of associated facilities is shared between the Contracting Parties in proportion to the value of the contributions to the annual Joint Programme of the AAO.

The Board has chosen to exercise its responsibility for the allocation of time on the AAT through arrangements made with the two government agencies responsible for implementing the AAT Agreement and its amendment, namely the Particle Physics and Astronomy Research Council (PPARC) in the UK, and the Department of Education, Science & Training (DEST) in Australia. Under guidelines set by the Board, these agencies operate through a single joint Time Allocation Committee - the Anglo-Australian Time Allocation Committee (AATAC) - which ranks all proposals for observing time on the AAT on the basis of scientific merit, and assigns each one an appropriate number of nights.

At 30 June 2006, membership of AATAC was:

Dr M Asplund (RSAA) *Chair*

Dr S Ryan (Herts) *Deputy Chair*

Dr M Drinkwater (Qld)

Dr R Webster (Melbourne)

Dr J van Loon (Keele)

Dr P Tuthill (Sydney)

Dr S Oliver (Sussex)

The AAO Users' Committee

The AAO Users' Committee (AAOUC) consists of six members external to the AAO: three members from each of 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 2006 the six AAOUC members were:

Australia	United Kingdom
Dr Andrew Hopkins (Sydney)	Dr Ian Parry (IoA) (Chair)
Dr Peter Wood (RSAA)	Dr Alastair Edge (Durham)
Dr Baerbel Koribalski (ATNF)	Dr Ian Howarth (UCL)

Glossary, Abbreviations & Acronyms

AAO	Anglo-Australian Observatory
AAOmega	An optical spectrograph
AAOmicron	Planned new instrument for the AAT
AAPS	Anglo-Australian Planet Search
AAOUC	AAO Users' Committee
AAT	Anglo-Australian Telescope
AASB	Australian Accounting Standards Board
AATAC	Anglo-Australian Time Allocation Committee
AATB	AAT Board
AEIFRS	Australian Equivalents to International Financial Reporting Standards
ANAO	Australian National Audit Office
ANU	Australian National University
APT	Australian Patrol Telescope
ARC	Australian Research Council
ASA	Astronomical Society of Australia
ATAC	Australian Time Assignment Committee
ATNF	Australia Telescope National Facility
AURA	Association of Universities for Research in Astronomy
CCD	Charge coupled device
CERN	European Laboratory for Particle Physics, Switzerland
CMB	Cosmic microwave background
Cosmology	The study of the origin and development of particular objects and systems in the Universe
CSIRO	Commonwealth Scientific and Industrial Research Organisation, Australia
CSS	Commonwealth Superannuation Scheme
CUDOS	Centre for Ultrahigh Bandwidth Devices for Optical Systems
DAZLE	Infrared narrowband imager
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
DR1	The RAVE First-Year Data Release
Durham	University of Durham, UK
Echidna	A fibre positioner being built for National Astronomical Observatory of Japan by the AAO
EEO	Equal Employment Opportunity
EEV	English electric valve CCD

ELT	Extremely Large Telescope
ESA	European Space Agency, Germany
ESO	European Southern Observatory, Garching, Germany
FBG	Fibre Bragg Grating
FLAMES	Fibre Large Array Multi Element Spectrograph
FMO	Finance Minister's Orders
FMOS	Faint multi-object spectrometer destined for the Subaru telescope
FTE	Full-time equivalent
GAIA	ESA's Global Astrometric Interferometer for Astrophysics
Gemini	Gemini Telescopes Project
Grating	see diffraction grating
HST	Hubble Space Telescope
Herts	University of Hertfordshire, UK
ICI	Instrument Control and Integration
ICS	Instrument Control Systems
IfA	Institute for Astronomy, Edinburgh, UK
IFU	Integral field unit
IoA	Institute of Astronomy, University of Cambridge, UK
IR	Infrared
IRIS2	Infrared imager/spectrograph
IT	Information Technology
JHU	Johns Hopkins University, USA
Keele	Keele University, Staffordshire, UK
KPNO	Kitt Peak National Observatory, Arizona, USA
Kuiper Belt	A region of the outer solar system containing comet nuclei
Melbourne	University of Melbourne
MMF	Multimode fibre
MOS	Multi Object Spectrograph
MOMFOS	Multi-object Multi-Fibre Optical Spectrograph
NAOJ	National Astronomical Observatory of Japan
NCRIS	National Collaborative Research Infrastructure Strategy
NOAO	National Optical Astronomy Observatory, USA
ODC	Optical Detector Controllers
OH	Oxygen+Hydrogen diatomic molecule
OH&S	Occupational Health & Safety
OPTICON FP	A framework program giving access to the AAT to EU astronomers
Oxford	University of Oxford, UK
OzPoz	A fibre positioner for the VLT

PATT	Panel for the Allocation of Telescope Time, UK
Photonics	The science of how light can be manipulated within materials
PI	Principal Investigator
PILOT	Proposed 2.4-metre telescope in Antarctica
PPARC	Particle Physics & Astronomy Research Council, UK
PSS	Public Sector Superannuation Scheme
Qld	University of Queensland
QSO	Quasi-stellar object
RAL	Rutherford Appleton Laboratory, UK
RAVE	RAdial Velocity Experiment
Redshift	The amount by which the wavelengh of light from a receding object is lengthened
REP	Orana Regional Environmental Plan
RGO	Royal Greenwich Observatory Spectrograph
RSAA	Research School for Astronomy and Astrophysics, Australian National University
SDSS	Sloan Digital Sky Survey
6dF	Six Degree Field facility for the UKST
6dFGS	Six Degree Field Galaxy Survey
SMF	Single mode fibre
SONG	Stellar Operations Network Group
Spectrograph	A device for disbursing light into a spectrum so that the intensity at each wavelength can be recorded by a detector
Spectroscope	An optical instrument that produces a Spectrum
SPIE	Society of Photo-Optical Instrumentation Engineers
SPIRAL	An IFU using fibres to feed a dedicated spectrograph
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
Super AAPS	An upgrade to the UCLES system designed to support the Anglo-Australian Planet Search program
Sussex	University of Sussex, UK
Sydney	University of Sydney
TAC	Time assignment committee
Taurus	Fabry-Perot imaging spectrograph
TCS	Telescope Control System
Tokyo	University of Tokyo, Japan
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)
UKST	UK Schmidt Telescope
UNSW	University of NSW
UIG	Urgent Issues Group — a group which issues interpretations that apply to the financial reporting period
UVES	Ultraviolet and Visual Echelle Spectrograph
VLT	Very Large Telescope
VPH	Volume phase holographic (grating)
WiggleZ	A Survey of high-redshift, star-forming galaxies
WFI	Wide Field Imager
WFMOS	Wide-Field Multi Object Spectrograph
WN star	Wolf-Rayet star of type N (nitrogen)
WO star	Wolf-Rayet star of type O (oxygen)

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