Australian Astronomy Decadal Plan
Working Group 3.2: National Facilities

Summary Papers on Existing and Proposed National Facilities

Prepared for a public meeting on 17 December 2004 at UNSW.

Version 1.1 (2004-Dec-14), Michael Drinkwater

Facility: Anglo-Australian Observatory

Matthew Colless (AAO)

Funding Institution:

Australian and British governments through DEST and PPARC

Background:

In 1969 the Australian and British governments 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 gave effect to this decision. The Act established the Anglo-Australian Telescope Board (AATB), a body corporate, which owns and operates the telescope. The Anglo-Australian Telescope (AAT) was opened in 1974. In 1988, the operation of another telescope on Siding Spring Mountain, the UK Schmidt Telescope (UKST), was transferred to the AATB. These two telescopes, together with the Marsfield headquarters facility and instrumentation laboratory collectively form the Anglo-Australian Observatory.

Further information can be found on the AAO website (http://www.aao.gov.au/) and in its Annual Reports (http://www.aao.gov.au/annual/).

Role of the Facility:

The mission of the Anglo-Australian Observatory (AAO) is to provide world-class optical and infrared observing facilities that enable Australian and British astronomers to carry out 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.

The AAO has been a major contributor to Australian and British astronomical research for the past thirty years. Each semester the AAO telescopes typically provide observing time to between 50 and 60 observing programs involving between 150 and 250 astronomers (on average 40% Australian, 40% British and 20% other). Time on the AAT is typically oversubscribed by a factor between 2 and 2.5.The oversubscription rate is likely to increase after the AAOmega spectrograph becomes available in early 2006.

Each year about 140 papers are produced using observations with the AAT or UKST. Of the 318 astronomers or students currently located at Australian institutions, 114 (36%) have used the AAO telescopes in the past 5 years. A review in 2000 by the European Southern Observatory showed that of the eight 4-metre class telescopes in the world, the AAT had the highest publication rate. Many of the papers based on AAT or UKST data are highly cited in the scientific literature. Of the 300 most-cited papers produced by the international astronomical community over the last three years (the top 0.5% of all papers), 17 made use of the AAO's telescopes.

Immediate Future of Facility:

The AAT Agreement and the new Supplementary Agreement provide for the continuation of the bi-national partnership until 30 June 2010. Over this time frame the AAO will continue to provide observing facilities to Australian and British astronomers. However the UK will halve its funding contribution in 2006-7 and again in 2007-8. The British share of time will be reduced pro-rata, and the Australian share will increase from 50% in semester 06A to ~67% in 06B and 07A, and then to ~80% from 07B to 10A. Contributions to the AAO's Joint Program over and above the recurrent contributions may vary these expected shares.

Operating the AAT is the primary function of the AAO, and the recent and ongoing streamlining of the AAO operations will permit the current level of support to be maintained throughout this period despite the reduction in recurrent funding by the UK. From semester 05B, the UKST will be supported on a user-pays basis; at least initially this support will be provided by the RAVE consortium. The AAO's instrumentation program will also need to be funded largely from external income in the form of instrument contracts (e.g. WFMOS for Gemini) and competitive grants (although UK recurrent funding will be reduced, the AAO is now eligible for PPARC grants).

Scientifically the AAO has much to look forward to. The current instrument complement (2dF, IRIS2, UCLES/UHRF, WFI) is very broadly capable, and will be significantly extended with the advent of the AAOmega spectrograph, which will be the most powerful survey spectrograph in the world from the time it comes on-line in semester 06A until WFMOS is built. Upgrades are also contemplated for IRIS2 and UCLES, although these will require external funding. The larger fraction of time available to Australian astronomers will enable larger, more ambitious projects to be undertaken with any of the AAT's instruments.

Future Vision of Facility:

Please see the attached paper for a more detailed vision of the AAO's future. The main recommendations are:

1. ***The AAO should be the national organization that supports all of Australia's major optical/infrared astronomy facilities.***

   The AAO (as the Anglo-Australian Observatory up to 2010 and as the "Australian Astronomical Observatory" thereafter) should not only operate the AAT and UKST but also be the support organization for Gemini and other major new optical/infrared facilities in which Australia has a share (e.g. an ELT, an Antarctic telescope, etc.).

2. ***The AAT is required as a major facility for Australian astronomers throughout the decade 2006-2015.***

   This means Australia needs not only to maintain the AAT under the Supplementary Agreement for the first five years (2006-2010), but also take sole responsibility for the telescope after the end of the Agreement (2010-2015).

3. ***A major new optical/infrared facility [TBD] is required by the end of the decade. At the appropriate time, the AAO would transfer its resources from supporting AAT operation to supporting operation of this new facility.***

   Australia should be aiming to obtain access to an ELT, Antarctic 8m, or equivalent major new optical/infrared facility by around 2015. The AAO should re-direct the operations cost of the AAT to operating/supporting this new facility. This may mean operating the AAT in full-cost-recovery mode, converting it to other purposes, or closing it down. A plan for a graceful transition is required.

4. ***The AAO instrumentation program is a world leader and should be supported at least at its current level.***

   The AAO should remain a source of innovative technology that gives Australian astronomers access to the best instruments on the best telescopes. Australia benefits from the AAO's instrumentation program and should be prepared to invest in it.

High Profile Work Done by the Facility

The 2dF Galaxy Redshift Survey, a map of 221,000 galaxies, measured the amounts of dark matter, baryons and neutrinos in the universe, and is one of the fundamental contributions to the standard model for the age, structure and constituents of the universe. The follow-up 2SLAQ survey is using 2dF and AAOmega to look at galaxies and QSOs at high redshift detected by the Sloan Digital Sky Survey in order to probe the evolution of large-scale structure.

The RAVE project is using 6dF on the UKST, and aims to measure the orbits for a million stars in the Milky Way over the next 5 years in order to find out how, and when, our galaxy was formed.

The Anglo-Australian Planet Search (AAPS) has discovered 20 planets around other stars and revealed the existence of worlds unlike any in the Solar System. As the AAPS time baseline increases over the next several years, the range of detectable planet types and the sample of stars searched will both be extended.

Other high-impact research from the past few years that used the AAO telescopes includes:

- The discovery of a new type of galaxy, the first in more than 70 years.
- The use of stellar seismology to probe the interiors of stars.
- The discovery of some of the most distant objects in the universe.
- The identification of massive gamma-ray bursts with exploding stars.
- The discovery of a satellite galaxy being torn apart by the Milky Way.

Further Information

Please consult the attached *Discussion Paper: The Next Decade of the AAO* by Matthew Colless for more details.

Facility: The Australia Telescope National Facility

Compiled by Naomi McClure-Griffiths & David McConnell (ATNF)

Funding Institution:

Approximately 70% by direct appropriation from CSIRO, 30% from external sources

Background:

The Australia Telescope National Facility (ATNF) became a National Facility in 1990 for operation under guidelines originally established by the Australia Science and Technology Council. As a National Facility, the Australia Telescope provides world-class observing facilities in radio astronomy for astronomers at Australian and overseas institutions.

The Australia Telescope consists of eight radio-receiving antennas: the six 22-m antennas of the Australia Telescope Compact Array (ATCA), the 22-m Mopra telescope and the 64-m Parkes Telescope. The ATCA has receiver systems covering the frequency ranges 1.2 – 1.7, 2.2 – 2.6, 4.4 – 6.7, 8.0 – 9.2, 16 – 25 GHz, and 84 – 106 GHz, and a maximum baseline of 6km. The Parkes telescope has receivers operating from 440 MHz to 22 GHz, including the thirteen beam 1.4 GHz multibeam and a new, highly sensitive 10/50 cm receiver.

The ATNF's mission is to operate and develop the Australia Telescope as a national research facility for use by Australian and International researchers; to exploit the telescope's unique southern location and technological advantages to maintain its position as a world-class radio astronomy observatory; to further the advancement of knowledge. The ATNF is the largest single astronomical institution in Australian; approximately 90% of the Australian radio astronomy is carried out through the ATNF. In the world context, the AT is one of the world's most powerful radio astronomy facilities and is the only major radio telescope in the southern hemisphere.

Role of the facility:

ATNF Usage:

The ATNF is operated as a national facility with time granted on the basis of scientific merit. In general the time requested for the ATCA and Parkes exceeds the time available by about a factor of two (see Figures 1 & 2 for exact oversubscription rates). The proposals are assessed and time allocated but the Time Allocation Committee, which is appointed by the ATNF Steering Committee.

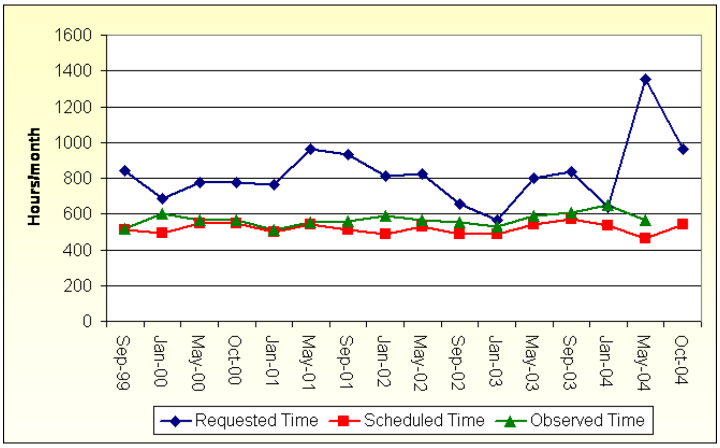


Figure 1: The requested time, scheduled time and actual observed time for observing terms from 1999 SEPT until 2004 MAYT.

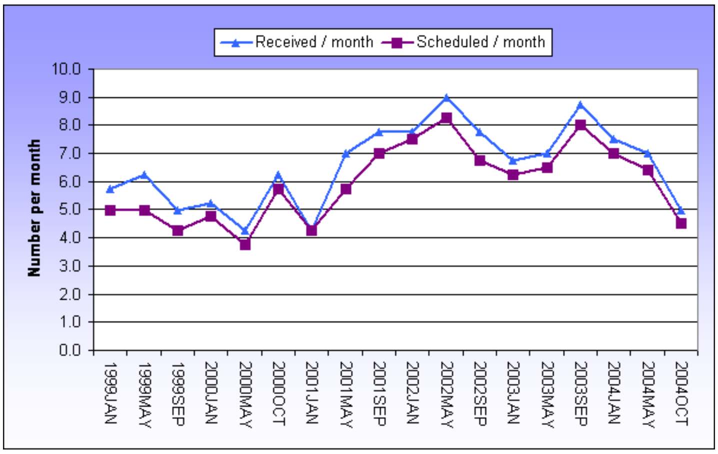


Figure 2: The total number of proposals received and scheduled for the Parkes radio telescope is shown for each observing term. Numbers are normalised by the number of months in each term.

Typically 40% of scheduled time on the ATCA and Parkes is allocated to proposals with Principal Investigators (PIs) from overseas institutions. The other 60% of scheduled time is allocated to proposals with PIs at the ATNF and other Australian institutions. The exact percentages for the years 1995 – 2004 for the ATCA and Parkes are shown in Figures 3 & 4, respectively. It has been a subject of concern of recent years that the number of proposals submitted by non-ATNF Australian PIs has been dropping.

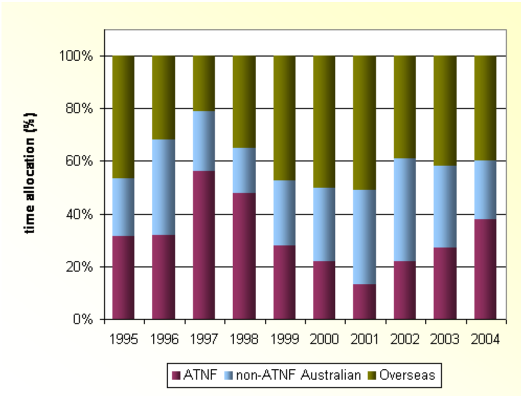


Figure 3: The time allocated at the Compact Array to proposals where the principal investigator is located at the ATNF, at another Australian institution, or overseas, shown as a percentage of the total time allocation.

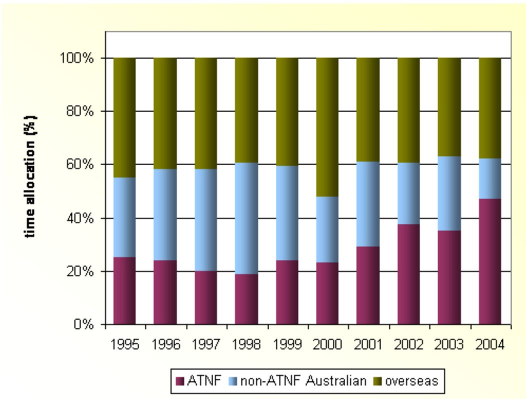


Figure 4: The time allocated at the Parkes to proposals where the principal investigator is located at the ATNF, at another Australian institution, or overseas, shown as a percentage of the total time allocation.

Publications:

On the basis of the number of refereed articles published with ATNF data each year, ATNF is the second most prolific radio facility in the world. The number of publications per year has been slowly increasing over the past 10 years, with the number of refereed papers for 2004 already exceeding 120. The annual number of papers published with ATNF data is shown in Figure 5.

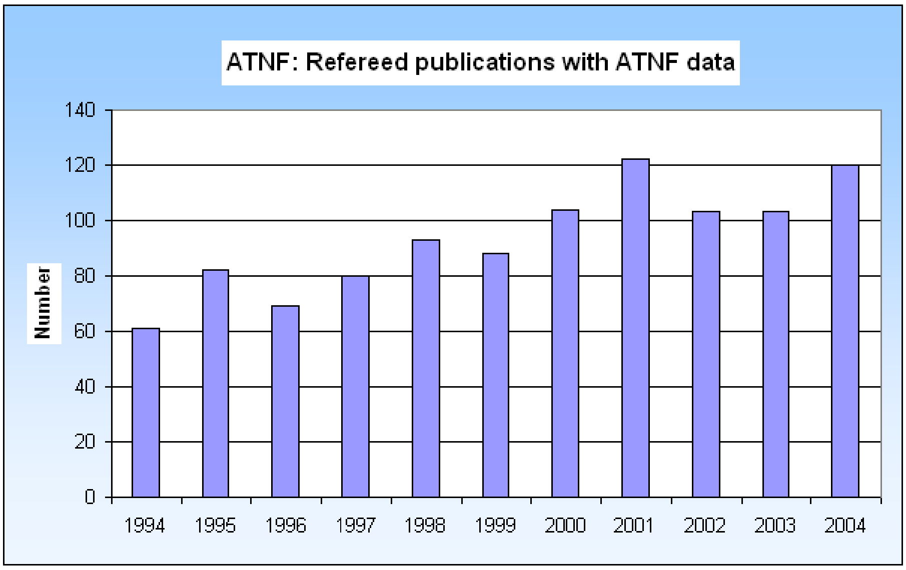


Figure 6: Total number of refereed publications that include data from ATNF facilities. For 2004 the number is a lower limit only as the full number of publications is not yet available.

Student Training:

ATNF supports an active program of student supervision. In 2003 there were 27 PhD students affiliated with the ATNF. ATNF students receive free accommodation at the ATNF sites, some support for page charges and funding for one overseas trip during their PhD. We also offer, through CSIRO, on average two top-up scholarships to exceptional students pursuing ATNF affiliated PhDs. The numbers of ATNF affiliated students over the life of the ATNF are shown in Figure 6.

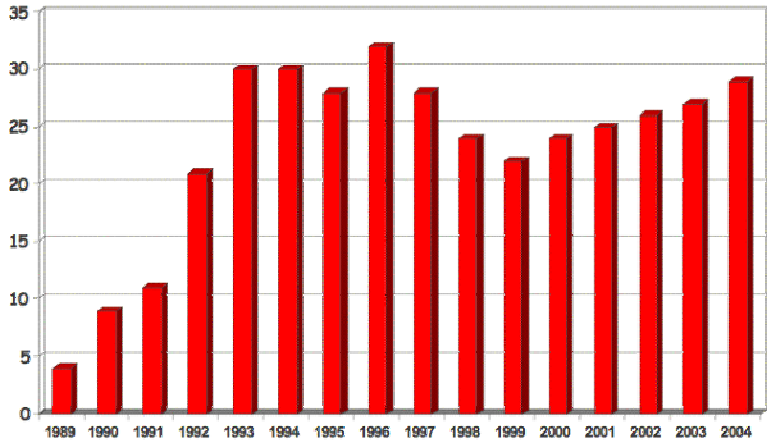


Figure 6: Number of postgraduate students affiliated with the ATNF.

Immediate Future of the Facility:

The ATNF will continue to schedule its telescopes in two six-month terms per year, starting in April and October. Astronomy at the shorter wavelengths (12mm and 3mm) on Mopra and the Compact Array will be scheduled preferentially in the April term. Major observing programs expected to use ATNF telescopes over the coming years include the ATCA 20GHz survey, the Galactic All-Sky Survey (GASS) at 21cm and the pulsar timing array observations at Parkes.

Current development projects and upgrades planned for the immediate future will enhance the technical capabilities of all ATNF instruments.

ATCA

- Increase of signal processing bandwidth from 128MHz to 2GHz (under development)
- New receivers for the 7mm band 26-50 GHz (funding being negotiated)
- Increase of receiver bandwidth in the cm-wave band, to access the 1-3GHz and 4-12GHz frequency ranges (proposed)

Mopra

- Spectrometer bandwidth upgrade to 8GHz for use in the 85-115GHz band.
- Access to the 16-26GHz band.

Parkes

- New digital filterbank with 1GHz bandwidth, 1024 channels, and synchronous pulsar integration with up to 1024 bins per period.
- 7-beam receiver to operate in the 6.0-6.7 GHz band.

Long Baseline Array

- High speed data transmission between LBA elements to increase bandwidth of VLBI observations and provide real-time correlation.

Future Vision:

(*The following points will be replaced by a more considered "vision" following internal ATNF discussion in February)*

Possible developments of the ATNF over the next decade:

- 20GHz focal plan array on Parkes
- Enhanced ATCA with 7th antenna and extended North Spur
- High-speed networks between all sites allowing possible consolidation of signal processing and computing facilities and new operational models for all telescopes.
- Operations at the Mileura site in WA with a 0.7-2.4GHz array with 5000 m^2 collecting area.

High profile work done by the ATNF:

Science Programs:

The ATNF has a long history of major scientific achievements. Some high impact projects recently carried out using the AT include:

- *The Parkes Multibeam Pulsar Survey,* a 21 cm multibeam survey searching for pulsars in the Milky Way. The Multibeam survey has discovered over 800 new pulsars since it began in 1997. This survey has discovered the first double pulsar system.
- *The HI Parkes All-Sky Survey (HIPASS),* which is an all Southern sky survey for extragalactic neutral hydrogen (HI) emission conducted with the Parkes multibeam receiver between 1997 and 2001. The survey created a catalog of 4300 HI selected galaxies, almost twenty times the size of any previous HI selected sample.
- *The ATCA Surveys of the Magellanic Clouds,* is an HI survey of the Small and Large Magellanic Clouds conducted with the ATCA. The surveys have allowed in-depth studies of the structure and dynamics of the neutral hydrogen ISM in the Magellanic Clouds.
- *The Southern Galactic Plane Survey,* is a high resolution survey of the neutral hydrogen and 21 cm continuum emission in the plane of the southern Milky Way. The SGPS is part of the International Galactic Plane Survey, which seeks to provide an atlas of neutral hydrogen in the Galactic Plane with arcminute resolution, 1 km/s spectral resolution and 1 K brightness temperature sensitivity.

Other high-impact research from the past few years include:

- The first double pulsar
- Carbon monoxide in High-Redshift Galaxies
- A new spiral arm for the Milky Way
- Dense molecular gas heated in starburst galaxies
- Discovery of a super-massive spiral galaxy

Technology and Instrumentation:

The ATNF has a very strong instrumentation group, specialising in the design and construction of radiofrequency receivers and high speed digital signal processing. ATNF receivers operate over the 0.5 to 1.5 GHz frequency range with sensitivities that keep Australian radio facilities at the world standard. The ATNF pioneered the use of cm-wave multibeam receivers for radioastronomy with the 13-beam 21cm receiver on the Parkes telescope. Over the past decade that receiver has made Parkes a world leader in galactic HI and pulsar studies. Its success has led to the contract ($1.4M) to construct a 7-beam receiver for the Arecibo 300-metre telescope in Puerto Rico, and a joint project with the Jodrell Bank Observatory to build a 7-beam 6GHz receiver for methanol surveys. The development of the recently completed 12/3.5mm systems for the Compact Array has included novel designs and fabrication techniques for microwave polarizers, 3-mm feed horns, and amplifiers both for the first stage and for LO generation and frequency conversion.

New generations of radioastronomy instrumentation increasingly are being developed with the FPGA (Field Programmable Gate Arrays) and MMIC (Microwave Monolithic Integrated Circuit) technologies. Applications of the MMIC techniques are the 8GHz analog correlator used on the ATCA for a 20GHz sky survey, wideband LNA designs aimed at a proposed future upgrade of the Compact Array cm-wave systems, and the development of a fully integrated receiver system on a chip. This work looks ahead to the requirements of large systems such as focal plane arrays and the SKA and aims to integrate a complete receiver, including LNA, filtering, down conversion, analogue to digital conversion and parallel to serial processing onto a single MMIC. The ATNF is applying FPGA technology to fast digital signal processing in the Compact Array broadband upgrade and the polyphase digital filterbanks it comprises.

Facility: The Australian Virtual Observatory

Michael Drinkwater (UQ)

Funding Institution:

Aus-VO first received ARC LIEF funding in 2003, with partners Universities of Melbourne and Sydney; AAO; ATNF. Additional work was carried out at the University of Queensland supported by an internal grant.

Work on Aus-VO in 2004 is partly funded an Australian Research Council Linkage Infrastructure (Equipment and Facilities) grant. The project partners are the Universities of Melbourne, Sydney, New South Wales and Queensland, Monash University, Swinburne University of Technology, the Australian National University & Mount Stromlo Observatory, the Victorian Partnership for Advanced Computing, the CSIRO Australia Telescope National Facility and the Anglo-Australian Observatory. These organisations provide matching funds totaling about 33% of the total cost of the projects supported.

Aus-VO is on the reserve list for 2005 ARC LIEF funding; through the APAC programme we have funding for 3.45 programmes through 2005 to work on infrastructure supporting Aus-VO. These include data warehouse programmers (Melbourne, ANU), theory portal programmer (Swinburne) and data pipeline programmer (UNSW).

Background:

Describe the History of the Facility

1. The International Virtual Observatory Alliance
"A Mission and Roadmap Statement 2002-2005" by Peter Quinn, Bob Hanisch and Andy Lawrence On the behalf of the ASTROGRID, AVO and NVO Projects June 10 2002

In the past twelve months, three major international projects have been funded to develop and realize the vision of using astronomical data repositories as virtual observatories. The total investment of funds in these projects is more than $20 million (US) over the next three-five years. The scope of these efforts is not limited to national boundaries but rather extends over the range of space and ground facilities utilized by the international astronomical community. Each project seeks to empower astronomers as they face the challenges of doing data-intensive scientific research in the 21st century; challenges that are also tobe met by our colleagues in many areas of the physical sciences. Each project also wishes to tap into the underutilized scientific potential of existing and future astronomical data repositories. The number of VO projects continues to increase as more and more communities of astronomers realize the challenge and opportunity before them. Each project shares common needs and seeks access to common ground. There is, therefore, a need to define this common ground and find ways of meeting the needs as an international astronomical community seeking to realize a VO with global capabilities.

http://www.ivoa.net/pub/info/

2. The Australian Virtual Observatory

The Australian Virtual Observatory (Aus-VO) will be a facility that provides a distributed, uniform interface to the data archives of Australia's major astronomical observatories, and to archives of astrophysical simulations. Aus-VO will be a key component of the International Virtual Observatory, a worldwide facility which will link the archives of the world's major astronomical observatories into one distributed database.

Astronomers will explore Aus-VO and the IVO using advanced data mining and visualisation tools. These tools will exploit a unified data interface to enable cross-correlation and combined processing of data from otherwise disparate sources.

Aus-VO has been a founding member of the International Virtual Observatory Alliance since June 2002. Australian astronomers have been active in the VO realm since December 2000. This work has had formal ARC LIEF funding in 2003 and 2004 (see above). Annual Aus-VO workshops with international speakers have been held 2002--2004.

http://www.aus-vo.org/

-Describe what it offers (e.g. instruments, telescopes)

1. International facilities

The IVOA only really has a coordinating role, defining standards etc, notably the "VOTable" format for data transfer. Tools and services are provided by individual national VOs. Data Analysis Tools : Starlink's (UK) TopCat, VOPlot (India), Mirage (Bell labs) Digital Sky Atlas : (AVO - Europe) Aladdin.

The CDS catalogue repository provides most major catalogues in VOTable format (allowing analysis with the above tools).

Open SkyQuery Service (NVO - USA) : Provides a standard SQL interface to allow distributed spatial queries of objects. Open SkyQuery allows the joining of different catalogues of objects where the data repositories are in different physical locations using a uniform interface.

2. Aus-VO:

- ATNF ATCA on-line archive (in collaboration with CSIRO ICT)
- ATCA pipeline under development,
- Adaptation of AIPS++ tools to the web
- Remote visualization system (RVS)
- SkyCat catalogue publication service
- VOlume visualisation tool (VOTable to VRML)
- AusVODownload utility, integrated into miriad
- Automated catalogue linkage techniques and data-mining tools
- Prototype theory portal (developed by APAC program into wider community including chemistry, earth systems)

Role of the Facility:

-Who uses it, how do they use it

Virtual Observatory tools in the general sense are already used by all astronomers if we include general databases such as NED and ADS. The newer "federated" tools and data services are still under development and mostly used by the immediate VO community. This is changing rapidly however

-data on research student training?

As above, most Australian RHD (graduate) students would use the general VO-type services. We expect an increasing number of students to undertake projects that are directly VO-related, as in the UK (numbers?) and USA (numbers?). In Australia we have the following:

UQ: 1 MPhil student. U. Sydney: 1 PhD, U. Melbourne: 1 MSc.

Immediate Future of Facility:

There are active Aus-VO programs underway at several Australian universities and observatories plus CSIRO as listed above. This has been jointly funded by the institutions and the ARC, so will continue at a reduced rate if not directly funded by the ARC. The immediate outcomes of this work will focus on the delivery of high-quality legacy data products from major Australian observational surveys, as well as the development of several specific data-mining and visualisation tools. In 2005 we plan to start the critical process of unifying the various components of the Aus-VO using the GrangeNet network backbone.

Future Vision of Facility:

It will take a further 3 years (2005-2007) to establish a fully functional Aus-VO. This involves the continued development of VO-comatible data products, new visualisation and data-mining software, and the network infrastructure and hardware needed to support the project.

High Profile Work Done by the Facility:

It is too soon to expect high-impact papers from VO work yet, but there are already some interesting results.

"Discovery of Optically faint obscured quasars with Virtual Observatory tools" (Padovani et al.2004, A&A, 424, 545) -- the first VO paper presenting science results

"Discovery of Brown Dwarfs with Virtual Observatories" (Berriman et al. 2003 in Large Telescops and Virtual Observatory: Visions for the Future, 25th meeting of the IAU, Joint Discussion 8, 17 July 2003) –cross-matched 2MASS and SDSS to recover known brown dwarfs: found the known ones but discovered more that had been missed.

The World-Wide Telescope (Szalay & Gray, 2001, Science, 293, 2037) – overview of the high-profile US effort especially.

Facility: The Australian National Institute for Theoretical Astrophysics

Pending; see http://www.anita.edu.au/

Facility: Research School of Astronomy & Astrophysics (also WG3.3)

(Ken Freeman, Version 1, November 29, 2004)

Funding institution:

ANU

BACKGROUND

The ANU assumed operation of Mt Stromlo Observatory (MSO) from the Commonwealth Government in 1956. The MSO telescopes at that time included the 74-inch, 50-inch and 30-inch reflectors and the Yale-Columbia refractor, In 1963 ANU opened the Siding Spring Observatory (SSO) near Coonabarabran. The 40-inch, 24-inch and 16-inch reflectors at SSO were acquired during the 1960s. The 2.3-m telescope, constructed in-house, began operation at SSO in 1984. The astronomy department of the ANU with its two observatories has changed name several times since 1956, and is now the Research School of Astronomy & Astrophysics (RSAA).

The facilities have also evolved over the years. The 2003 Canberra bushfires destroyed all of the Mt Stromlo telescopes and much of the infrastructure; only the research office and computing facilities survived. The 16-inch reflector at SSO is now rarely used. The 40-inch telescope is used almost entirely for imaging with the widefield CCD imager (8K x 8K). The 2.3-m telescope has a suite of instruments for general-purpose imaging and spectroscopy.

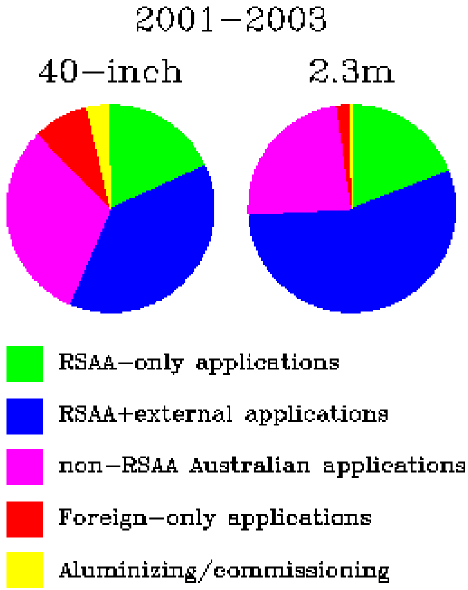
ROLE OF RSAA

The mission of RSAA is to

- advance the observational and theoretical frontiers of astronomy and its enabling technologies,
- provide national and international leadership, and
- train outstanding scientists.

RSAA now has about 30 PhD researchers and about 30 graduate students. Its researchers are world leaders in many areas of observational and theoretical astrophysics. Their research interests cover a very wide range of astrophysics, from planetary science to cosmology. RSAA is active in instrument building, with two current contracts for major multi-million dollar Gemini instruments (the NIFS spectrometer and the GSAOI adaptive optics imager), other smaller external contracts, and some large internal instrument projects (the SkyMapper telescope and the WiFeS spectrometer for the 2.3-m telescope). For more information, see www.mso.anu.edu.au

The RSAA is funded as a university research school through the ANU. Its telescopes are a university facility rather than a national facility, but are available for use in open competition to all Australians and overseas astronomers. The level of support and variety of instrumentation that can be offered are necessarily not at the same level as in the National Facilities. For the two major surviving RSAA telescopes, statistics on telescope useage by RSAA and non-RSAA astronomers are presented for the years 2001-2003 in the figure below.



The two telescopes are currently only marginally oversubscribed, but the subscription rate is certain to increase in the next few years when (i) the SkyMapper telescope, with its much wider field, replaces the 40-inch telescope for widefield imaging and (ii) the new WiFeS IFU spectrometer comes into operation on the 2.3-m telescope.
At this time, 21 of the 30 RSAA graduate students have started their thesis research. Of these 21 students, 14 depend at least in part on the RSAA telescope facilities for their thesis data.
Detailed statistics on publications from observations with RSAA telescopes are available only for the pre-bushfire years 2000-2002. The table below shows that the RSAA facilities generated 86 of the 294 RSAA papers published in this period, with another 16 papers coming from non-RSAA users.

Publications from RSAA telescopes 2000-2002

Data source	RSAA papers	Non-RSAA papers	Total papers	% of total papers
50-inch	24	0	24	8
74-inch	4	8	12	4
24-inch	11	1	12	4
40-inch	14	3	17	5
2.3m	33	4	37	12
Other/theory	208	0	208	67
TOTAL	294	16	310	100

RSAA IN THE FUTURE

As a university facility, RSAA is likely to continue its current style of operation as the major Australian research training group in astronomy. Several outstanding young astronomers have recently been appointed to tenured positions, and the continued research strength of RSAA seems assured. The number of graduate students at RSAA

is gradually increasing, and this growth is likely to continue. We can expect that RSAA astronomers will continue their vigorous use of large international ground and space-based telescope facilities.
The cloud cover statistics and the seeing at Siding Spring Observatory are relatively poor by international standards. These shortcomings are partly offset by the ease of accessibility for observers and for technical support, so the RSAA's suite of medium-aperture telescopes at SSO will continue to be well suited to research training and large dedicated observing programs. The MACHO microlensing program undertaken with the robotic MSO 50-inch telescope during the 1990s is an example; this program has already generated more than 60 refereed papers, with more to come. A new Advanced Instrumentation Technology Center (AITC) is under construction on Mount Stromlo. Adaptive optics will be a major focus in technology development. The 1.3-m SkyMapper widefield telescope is also under construction, and will be used initially for a "Southern Sloan" sky survey. Fabrication will soon begin on an advanced IFU spectrometer (WiFeS) for the 2.3-m telescope, funded by a Systemic Infrastructure Grant. This will greatly increase the spectrometric capability of this telescope. The expected high throughput and relatively high resolution of WiFeS will enable detailed studies of high redshift galaxies with a telescope that is relatively small by today's standards.
The RSAA facilities on Siding Spring will continue to be available to Australian and international astronomers. Remote operation of the SSO telescopes and instruments is a major goal for the near future.
The AITC and SkyMapper telescope represent the first phase in the bushfire reconstruction program for RSAA. Future plans include reconstruction of the historic main building and library at MSO, and replacement of the much-used high resolution spectrometric facility that was lost when the 74-inch telescope was destroyed.

HIGH PROFILE WORK AT RSAA

Recent high profile work includes the discovery of the accelerating universe, the MACHO, RAVE, 2dFGRS and HIPASS projects, discovery of the most metal-poor stars, the chemical abundance of the sun, and models for starburst galaxies, .

Facility: The University of Tasmania Observatories (also WG3.3)

For information only as this is mainly covered by WG3.3 University Facilities.

Simon Ellingsen (UTas)

Funding Institution:

University of Tasmania (Salaries + maintenance + some running costs)

ARC (Salaries + equipment + travel)

Consulting (everything not covered by the University or ARC e.g. page charges, other running costs)

Background:

-Describe the History of the Facility

-Describe what it offers (e.g. instruments, telescopes)

The University of Tasmania operates two radio astronomy observatories. The Mt Pleasant observatory is approximately 20 km from the University of Tasmania main campus at Hobart. The observatory has two telescopes, a 26m prime focus parabolic antenna which was donated to the University by NASA in 1985 (it was previously located at Orroral Valley near Canberra) and a 14m prime focus parabolic antenna built at the University of Tasmania.

The 26m antenna has state of the art radio astronomical equipment, including cryogneically cooled receivers that operate in a range of frequency bands from 1.4-25 GHz, a flexible digital autocorrelation spectrometer (based on the Parkes multibeam correlator design) and S2, MKV and MRO VLBI recording systems. It is used for a wide variety of types of observations including monitoring of the flux density of AGN, searches and monitoring of molecular masers and timing of pulsars. It plays an important role in the Australian Long Baseline Array and the International VLBI Service geodetic VLBI array. When not participating in VLBI observations the antenna is in constant use for staff and student research projects and as a teaching facility for undergraduate students.

The 14m antenna is dedicated to making timing of the Vela pulsar, which it has been doing 18 hours per day continuously for a period of more than 20 years. The 14m antenna makes simultaneous observations in 3 frequency ranges centred on 650, 990 and 1320 MHz. The main purpose of the Vela experiment is to catch the pulsar in the act of glitching (sudden changes in the arrival time of the pulsar), which it has done on 6 occasions. Observations made with the 14m antenna shows that the spin-up time for the glitch is less than 10 seconds and place tight constraints on the neutron star equation of state.

The Ceduna observatory is approximately 40 km north of the town of Ceduna, which is 850 km west of Adelaide. The observatory has a 30m Nasmyth focus antenna which was donated to the University by Telstra in 1995. Similarly to the Mt Pleasant 26m the Ceduna 30m is able to make sensitive observations over a wide frequency range (2-25 GHz). The antenna is a vital element in the Australian Long Baseline Array (LBA), being the only antenna west of the main concentration of telescopes in

NSW, it is involved in LBA observations approximately 3 weeks each year. When not involved in VLBI The Ceduna 30m antenna is used for the COSMIC (COntinuous Single dish Monitoring of Intraday variability at Ceduna). COSMIC commenced in March 2003 and is the world's first experiment dedicated to monitoring intraday variability for sources which show characteristic timescales in excess of a few hours. COSMIC is able to measure the flux density of sources stronger than 1 Jy to an accuracy of better than a few percent and is yielding interesting results, groups in the US and Japan are setting up projects to copy COSMIC.

Role of the Facility:

-Who uses it, how do they use it.

Immediate Future of Facility:

Future Vision of Facility:

Future upgrades:

Fibre optic links - Mt Pleasant $500k (ARC LIEF application in, awaiting results) Ceduna $500k - $2M (2005/6, funding source unknown)

Broadbanding of receivers - Mt Pleasant & Ceduna $500k (2006, funding source unknown)

Future role:

The Australian Long Baseline Array is a national facility operated jointly by the Australia Telescope National Facility and the University of Tasmania. The future role for the Mt Pleasant and Ceduna antennas is to remain part of that array. The plan is to link all the antennas in the array with fibre optics with 10 Gbps capacity and use the ATCA broadband correlator for form the world's most sensitive VLBI array, operating in real-time by 2007. The Mt Pleasant and Ceduna antennas will continue with similar projects to those currently being undertaken when not participating in VLBI observations.

Sources of future funding:

Same as current sources of funding, but attempting to increase consulting and external funding sources and use these to expand personnel and fund future upgrades.

High Profile Work Done by the Facility:

Proposed Facility: Centres of Excellence Program

Outline of a possible future facility
Sam Barden (AAO)

Funding Institution:

Australian Research Council (ARC)

Role of the Facility:

The following is extracted from the ARC Centres of Excellence web site (http://www.arc.gov.au/grant_programs/centre_excellence.htm):

The ARC has established Centres of Excellence program to create the scale and focus necessary to maintain and develop Australia's international standing in Australia's areas of research priority. Through highly innovative research that addresses challenging and significant problems within the priority areas these Centres will build national research capability and produce outcomes of economic, social and cultural benefit to Australia.
ARC Centres of Excellence are funded under Backing Australia's Ability - Building our Future through Science and Innovation which is a new initiative of the Australian Government over 6 years from 2004-5.

Objectives are:

- undertake highly innovative research at the forefront of developments within areas of national importance, with a scale and a focus leading to outstanding international and national recognition;
- enhance the scale and focus of research in designated National Research Priorities. In 2003, the Government designated the following areas as National Research Priorities for Commonwealth-funded research:
  - Research Priority 1: An Environmentally Sustainable Australia
  - Research Priority 2:Promoting and Maintaining Good Health
  - Research Priority 3: Frontier Technologies for Building and Transforming Australian Industries
  - Research Priority 4: Safeguarding Australia;
- promote research that will enhance Australia's future economic, social and cultural well being;
- link existing Australian research strengths and build new capacity for interdisciplinary, collaborative approaches to address the most challenging and significant research problems;
- build Australia's human capacity in a range of research areas by attracting, from within Australia and abroad, researchers of high international standing as well as the most promising research students;
- provide high-quality postgraduate and postdoctoral training environments for the next generation of researchers in innovative and internationally competitive research;
- offer Australian researchers access to world class infrastructure and equipment, and to key research technologies;

- develop relationships and build new networks with major international Centres and research programs that help achieve global competitiveness and recognition for Australian research;
- establish Centres of such repute in the wider community that they will serve as points of interaction among higher education institutions, Governments, industry and the private sector generally.

Immediate Future of Facility:

Proposals need to be defined and submitted. Duration of the funding cycle is ~6 years.

Future Vision of Facility:

This is an avenue to pursue funding of research centres tied to the existing and desired future national and international facilities available to the Australian astronomical community. The pursuit of science oriented centres can provide linkages between the universities and research facilities to allow Australia to become significant partners, if not leaders, in the pursuit of key astronomical studies such as understanding dark energy, the formation of galaxies, or the study of extra-solar planetary systems.

A well defined centre will attract students from around the world; will provide research jobs in Australia; will help answer some of the most fundamental questions facing astronomy and physics; will provide a strong science based reason for our pursuit of research facilities such as ELT's, Antarctic telescopes, and instrumentation for all of our facilities; and will provide an excellent platform for educational outreach programs.

The following is one of many possible examples of a science oriented centre concept and is just given as an example. The decadal review should identify the various areas that these centres should pursue. An ambitious approach would be to pursue ~3 or so independent centres covering different astronomical objectives. For example, 3 possible centres: one on dark energy, one on extra-solar planets, one on stellar physics (asteroseismology).

Example:
Science objective: Understand the nature of dark energy

The centre would focus on this scientific objective through the following means:

1. Establish a research centre that has a research oriented staff ranging from senior scientists to post-docs and students.
2. Link efforts to the universities to engage their staff and provide the educational outreach of the centre.
3. Link with overseas institutions to help lead the global effort on this topic.
4. Provide impetus and support for the development of new facilities. In this case, a near term facility would be the Gemini wide field MOS system under development to conduct a massive redshift

survey to detect the wiggles due to dark energy as a function of redshift. This particular centre would also have linkages into projects like SNAP, SKA, ELTs, and numerous other facilities (8-m Antarctic telescope, etc.).

5. Be engaged in the collection of data through surveys, data reduction, analysis, etc.

The outcomes of such a centre might include:

1. Establishment of an internationally recognized centre of excellence in Australia addressing a global scientific question.
2. Education.
3. Aid in development of Australian astronomical infrastructure.
4. Make Australian astronomers more desirable for collaboration on international ventures.
5. Growth in Australian astronomy job market.
6. Science justification for securing Australian funds for Australian involvement in international-scale facilities such as ELTs.

High Profile Work Done by the Facility:

The following web site lists the recently awarded centres:
http://www.arc.gov.au/grant_programs/2003_coe_funding.htm