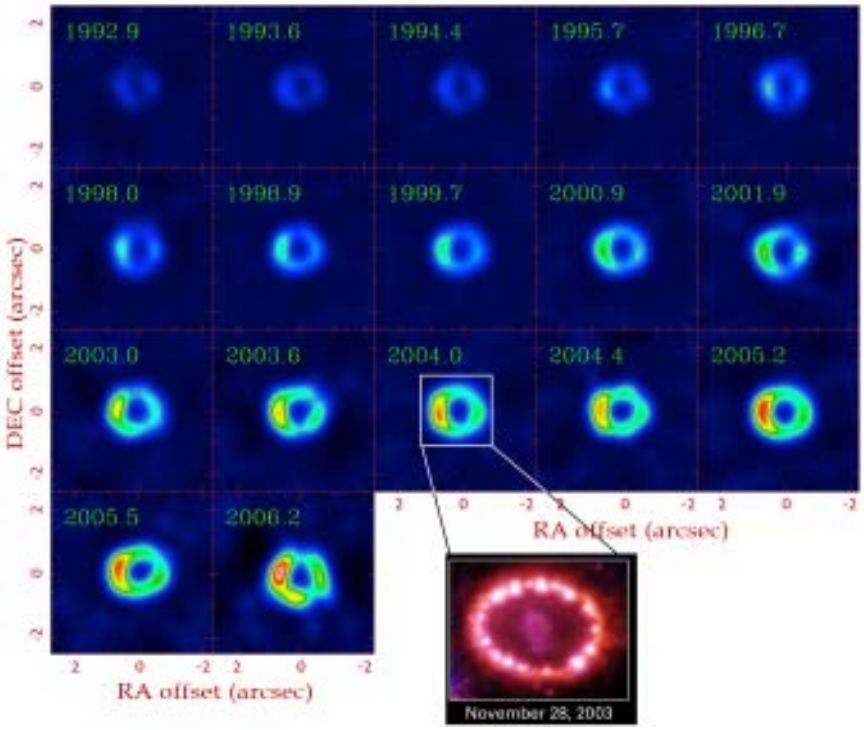
ATNF News

Supernova 1987A: 20 years old and still growing stronger!

The news of a new supernova in the Large Magellanic Cloud quickly swept around the world after its discovery by Canadian astronomer Ian Shelton at Las Campanas Observatory, Chile, on 24 February 1987. A neutrino burst, which signified the event as a type II core-collapse supernova (SN), was retrospectively detected by Kamiokande II and other detectors at UT 07:35 on 23 February.



Compact Array observations of SN1987A at 8 GHz between 1992 and 2006. The images shown have been super-resolved to a resolution of 0.5 arcsec and were taken at multiple frequencies in the 3-cm band and typically include two complementary 6-km configurations. The inset photo is a high-resolution optical image from the Hubble Space Telescope's Advanced Camera for Surveys (ACS), courtesy NASA, P. Challis, R. Kirshner and B. Sugerman.

Being the brightest supernova for 400 years, and the closest supernova since the invention of the telescope, it was an amazing event. Many astronomers not previously noted for their expertise in supernovae rapidly became inducted if they happened to be sitting at a suitably southern telescope at the time. For radio astronomers, it was unfortunate that the Compact Array was still a few years from being operational. However, the Sydney University Molonglo Observatory Synthesis Telescope and the Fleurs Synthesis Telescope were operational and, within a few days, the Australian Very Long Baseline Interferometry (VLBI) network also swung into action. Early detections, summarised by Turtle et al. (1987) and Storey & Manchester (1987), were extremely important in understanding some of the blast wave astrophysics, including the density of the immediate circumstellar environment. Even the VLBI non-detection (Jauncey et al. 1988) was important in establishing

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Editorial

Welcome to the February 2007 edition of the ATNF News.

In this issue's feature article, Lister Staveley-Smith discusses the 20-year history of supernova 1987A. Our front cover, printed for the first time in colour, presents a montage of images of the supernova obtained with the Compact Array over fourteen years.

Two science news items give status reports of on-going large Compact Array observing projects: A large-scale imaging survey of Centaurus A is described by Ilana Klamer and a first account of an optical and radio survey investigating the evolution of Southern Compact Groups of galaxies is given by Michael Dahlem.

On technical matters, Paul Roberts reports on the development of an analogue-to-digital converter board for the Compact Array Broadband Backend (CABB) upgrade, while Tim Cornwell, David McConnell and Mark Calabretta discuss the review of the Miriad data reduction software package and recent upgrades to it.

Elaine Sadler, the new Chair of the Australia Telescope Users Committee (ATUC) reports on the meetings held in June and October 2006.

The time assignment report includes advice for observers who may wish to submit proposals for large projects. Some changes to the proposal submission process will take effect from the next application deadline on 15 June 2007.

Sadly, shortly after his visit to the ATNF in late 2006, Jim Cohen passed away. James Caswell's tribute honours Jim for his many contributions, and especially as a leading contributor to the Parkes Methanol Multibeam Survey.

Your contributions to the ATNF News are always welcome. The web version of this and previous issues can be found at *www.atnf.csiro.au/news/newsletter*. For those who would like to print their own copy of the newsletter, we are now also providing the newsletter in pdf format.

Michael Dahlem, Jessica Chapman and Joanne Houldsworth
The ATNF Newsletter Production Team
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Due to an error at the printing stage, the contents of the article on "ATNF distinguished visitors" were not reproduced in the printed version of this newsletter. We apologise to our readers and to the author, Naomi McClure-Griffiths, for the oversight.

Contents

News

From the Director

The last few months have seen a number of major developments at the ATNF.

In October last year The Hon. Julie Bishop, Minister for Education Science and Training, announced new investment for the Mileura International Radio Array (MIRA) totalling $19.2M as part of the $45M new investment in optical and radio astronomy as part of the National Collaborative Research Infrastructure Strategy (NCRIS) investment plan. Of this, an amount of $14.6M is earmarked to develop 30 12m-diameter antennas with smart-feeds operating in the range 0.8–1.6 GHz; the large N small D component of MIRA, or MIRA-NdA (large N, small D array). Coupled with further investment from CSIRO, the State Government of Western Australia and Canadian collaborators, this will deliver an important new component to the National Facility, capable of addressing key questions in galactic structure, galaxy evolution and fundamental physics. We can look forward to developing further scientific and engineering collaborations with key partners at the "Focal Plane Array and Science with MIRA" workshops which will be held at the ATNF in mid-March.

A further $4.6M were earmarked in the NCRIS investment package for the low-frequency MIRA Wide-Field Array, or MWA. The MWA will probe the formation of the first structures in the Universe, explore the largely uncharted territory of radio transients and study solar/heliospheric physics. It is a joint collaboration between MIT/Harvard-Smithsonian Centre for Astrophysics and a number of Australian Universities, the ATNF, and India. The Australian effort is led by the University of Melbourne. The investment in radio astronomy, and indeed in Australian astronomy as a whole demonstrates both the high regard for, and strategic importance of, Australian astronomy at the very highest levels of government.

Working with the State Government of Western Australia (WA), CSIRO recently advised on the suitability of a site located some 75 km from the originally proposed SKA site, Mileura. This new location, still within the region originally encompassed by the area protected for radio astronomy by Section 19 of the WA Mining Act in Australia's original proposal to site the SKA, is more compatible with the emergence of mining activities in the area, and the associated infrastructure. The revised site is on the Boolardy station and offers a 70-km buffer to enable radio astronomy and mining activities to co-exist in the Mid-West region of Western Australia. In a statement earlier this month, the Premier of Western Australia, the Hon. Alan Carpenter, MLA, said the State Government would continue to work with the Commonwealth to develop appropriate mechanisms, including legislation, to protect the radio quietness of the new site.

In support of these developments the ATNF continues to attract excellent individuals. Over the past three months I have been delighted to welcome Dave DeBoer (Assistant Director: MIRA), Robert Braun (Assistant Director: Astronomy) and Phil Crosby (Business Strategist) to the Leadership Team. Furthermore, the ATNF also has six outstanding new postdoctoral appointments arriving over the next few months to further strengthen our astrophysics group.

The Leadership Team has also seen one further change.Warwick Wilson has signalled his wish to move on from his position as Assistant Director: Engineering to focus more intently on the delivery and implementation of the Compact Array Broadband Backend (CABB) system in the years ahead. While I am sorry to lose Warwick's experience and managerial skills as Assistant Director: Engineering, freeing up more of Warwick's world-class engineering ability to focus on the vitally-important CABB project represents an excellent outcome for the ATNF. Graeme Carrad has agreed to fill the position of Assistant Director: Engineering on an acting basis, while we conduct a recruitment process. Over the past few years, Graeme has had considerable success as Project Manager of the ALFA project, the 7-mm receiver project — now undergoing integration at the Compact Array — and the CABB project. I look forward to working with Graeme as part of the Leadership Team over the coming months.

Brian Boyle
ATNF Director
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Jim Cohen (1948 – 2006) and the methanol multibeam survey

Jim died 1 November 2006 — to the dismay of all who knew him. A fitting tribute was published in the UK Telegraph, Tuesday 7 November (online at *telegraph.co.uk*). The obituary records Jim's many contributions to Jodrell Bank and to the worldwide astronomical community. Jim was a meticulous research scientist, a teacher especially appreciated by successive research students, and, through the International Telecommunications Union, was heavily involved in negotiations to regulate radio spectrum usage so as to protect radio astronomy from interference — negotiations where his diplomacy and quiet humour were most effective.

At the ATNF, we have fond memories of an exceptional trusted friend and colleague, of great personal and scientific integrity. In 2006, Jim was a distinguished visitor with the ATNF for several months, based at Epping and making extensive trips to the observatories, especially Parkes. He was here primarily to ensure a successful beginning for the methanol multibeam maser survey, from which the first results, and receiver details, are described in the *ATNF News* February 2006, Issue No. 58. Jim devoted enormous energy to the project and was the key participant at every one of our six major observing sessions over the past year. Jim's wife Pat was fortunately able to be involved with the survey firsthand and help us on one of the long Parkes Observatory sessions.

The methanol survey is a major collaborative effort between Jodrell Bank and the ATNF, with the survey and follow-up involving astronomers from nine institutions; more than half of the astronomers are from the UK, led by Jim. The sad loss of Jim from the team has inevitably increased the workload on the other team members, but as we reach the halfway stage of the 2-year Parkes portion of the survey, we are very pleased to be well on track to achieve Jim's vision for the project. A progress report will be made at the international maser meeting in Alice Springs in March (IAU Symposium 242), where Jim was intended to be an invited speaker. It will be an ideal opportunity for his maser colleagues from many countries to recall the many good times they have spent with Jim.

Photo: John Reynolds

Jim and Pat Cohen at Parkes 2006

The completion of this survey over the next few years will be a legacy of Jim's efforts. But — we miss you Jim... and when the critical decisions need to be made, rest assured that we will all be reflecting carefully on what you might have suggested.

James Caswell
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A high-speed ADC and data transmitter board for the CABB upgrade

One of the challenges in the Compact Array Broadband Backend (CABB) upgrade project has been in developing an analogue-to-digital converter (ADC) board capable of supporting the 4,096 GigaSamples per second (GS/s) rate required for processing the 2 GHz of bandwidth demanded by the upgrade. The CABB project has aimed to use a much higher number of bits for quantising than has been traditional in the past. This is to allow for handling and potentially removing radio frequency interference in the signal processing, as well as increased sensitivity. This means that the previously developed ATNF 8 GS/s 2-bit sampler chips, as used in the **Mop**ra **S**pectrometer (MOPS), cannot be used for the CABB upgrade. There are no commercially available ADC devices that meet this operation speed.

Our solution has been to develop an ADC subsystem composed of two commercial 2 GS/s 10-bit ADC chips operated in an interleaved fashion. The same input is distributed to the two converters with the sampling times of the two converters in precise anti-phase, to give an equivalent 4 GS/s 10-bit converter. This requires extremely tight matching of the two channels in terms of sampling phase, gain, bandwidth, and offset. We have built onto the board high resolution calibration and trimming circuitry that can control these parameters to the level required, and developed algorithms to automatically measure and adjust these trims in real time.

The performance achieved currently over the 2 – 4-GHz CABB intermediate frequency (IF) band at full sampling rate is a signal-to-noise ratio (SNR) of typically 38 dB (equivalent to an 'effective number of bits' of ~ 6) and spurious free dynamic range (SFDR) of 39 dB. We are working on an approach to try and improve these figures further.

In addition to analog-to-digital conversion, the CABB ADC/data transmitter board also performs framing and transmission of the data. It takes the 40 Gbit/s of converted data, then frames it into 4 x 10 Gbit/s serial data streams and thence to laser driver chips for directly driving external modulated lasers. In the CABB system these are different wavelength optical data streams that are then multiplexed onto a single fibre for transport from the antennas to the control building.

The board has been designed to be as general as possible to allow it to be used in other applications apart from the CABB upgrade. It can be used as two independent 1-GHz bandwidth ADCs for instance, instead of a single 2-GHz bandwidth ADC, if required. It is being employed in this capacity in the soon to be commissioned 1-GHz pulsar digital filter bank correlator for Parkes, and for a radio transient detection experiment proposed for later this year at the Compact Array.

Paul Roberts
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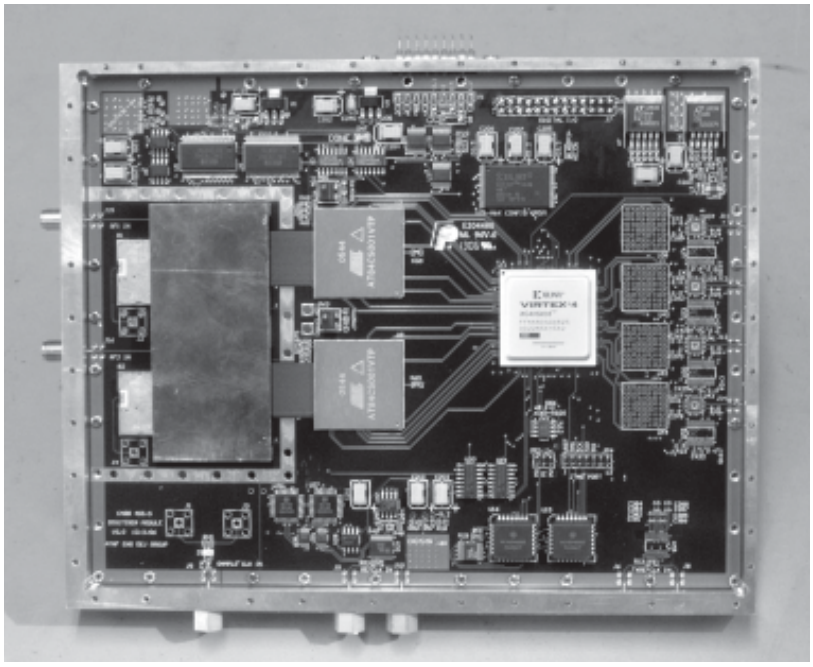

Photo: Paul Roberts

CABB ADC/data transmitter board

MIRA developments

For some time, the xNTD project team, led by CSIRO, has been coordinating with the Low Frequency Demonstrator (LFD) team, led by Massachusetts Institute of Technology (MIT), with the expectation and intention to co-locate these instruments and share infrastructure in Western Australia (WA). Combining two different instruments on a common infrastructure platform enhances the science from both, and is a direct analogue to the plans for the Square Kilometre Array (SKA). This combined instrument is called MIRA — the Mileura International Radio Array. MIRA will be housed within the Murchison Radio Observatory, the area in WA's Murchison Shire that has been given protection for radio astronomy.

The component of MIRA implemented with focal plane arrays on dishes, formerly called the xNTD, is now called MIRA-NdA (pronounced "mir-**an**-da"): this stands for the MIRA-large-**N** (number), small-**d** (diameter) **A**rray, and will have a large number of small parabolic dishes and "smart feeds".

Antenna feeds

As noted in the October 2006 issue of *ATNF News*, the ATNF is operating a two-element interferometer at Marsfield to test the performance of a Thousand Element Array (ThEA) tile made by the Netherlands Foundation for Research in Astronomy (ASTRON). The interferometer uses a 21-element input/one-beam output beamformer/correlator, controlled with a Python-based control system. Recent work by Doug Hayman, Tim Cornwell and a summer vacation student, Anthony Whelan, has concentrated on improving the calibration, mostly by using a noise source on the surface of the antenna.

The ATNF has also developed a new design for a linear connected phased array (i.e., connected dipole-like elements). We have undertaken extensive modelling, and built and measured a small prototype array, which has validated the modelling. We found that it was difficult to connect the array elements to the low-noise receivers without disturbing the radiation properties of the array.

We have now explored a variation on this design in which the dipole wires have been "fattened" to become square elements arranged in a checkerboard pattern. This solution turns out to have very good performance, as shown by modelled antenna beam patterns and gains, and good receiver-matching characteristics. Its checkerboard structure is also a "self-complementary screen", with predicted properties that are confirmed by our modelling. We are now building a prototype of such an array.

In collaboration with the Dominion Radio Astrophysical Observatory (DRAO) in Canada, we are continuing to measure and model phased array feeds based on Vivaldi elements. These and other designs for phased array feeds will be tested on a test antenna at Parkes, discussed below.

Antennas

CSIRO recently awarded a contract to Patriot Antenna Systems of Michigan, USA, to install a 12-m antenna at the Parkes Observatory. This antenna will be used to continue the study of phased array feeds. Site works have begun at Parkes. The antenna will be constructed by Patriot in Michigan in August 2007 and erected at Parkes in September of this year.

Studies for the MIRA-NdA antennas continue. On 12 December 2006 an antenna design working meeting was held at ATNF headquarters, with participants from CSIRO, DRAO and a team of five engineers from Connell Wagner. The DRAO team visited ATNF during 11 – 15 December 2006; meetings with them covered a range of MIRA-NdA activities. We are continuing to investigate novel antenna configurations for MIRA-NdA — those that will be able to achieve a wide field-of-view and high dynamic range. A number of options will be prepared for the MIRA-NdA antenna Critical Design Review in September 2007.

Staff

Five new staff members have joined the MIRA project at the ATNF in recent months. David DeBoer, formerly Project Manager with the Allen Telescope Array in the USA, has taken over from Colin Jacka in directing MIRA-NdA and SKA technical activities at the ATNF; however, Colin remains with the project on a part-time basis. Anthony Schinckel, formerly the Director of Operations for the Smithsonian Submillimetre Array in Hawai'i, has joined the project as a manager. Yuantu Huang and Juan-Carlos Guzman have been hired to work on the MIRA-NdA archive and central processor, respectively. Yuantu trained in China and the Australian National University (ANU) as a mathematician; Juan-Carlos worked for a number of years at La Silla

Observatory in Chile in real-time control systems. Tim Bateman has joined us to program the Parkes digital beamformer, 192 inputs at tens of MHz bandwidth: he comes from industry and has had extensive experience in programming application-specific integrated circuits (ASICs).

Helen Sim and Dave DeBoer
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Miriad review

Miriad has been an essential tool for the Compact Array for many years. Due to the diligent and careful work of Bob Sault, it has supported the key science of the Compact Array while maintaining a reputation for simplicity, robustness, and excellent documentation (thanks in large part to the work of Neil Killeen).

On 9 June 2006, in response to a request from the ATUC, the Director convened a panel to review the future of Miriad at the ATNF. The panel members were Steven Tingay (Swinburne, Chair), Tim Cornwell (ATNF), Naomi McClure-Griffiths (ATNF), Tony Wong (UNSW/ATNF), and Vince McIntyre (ATNF, ex officio). The terms of reference for the committee and a brief summary of the response follows:

- **Do users still see Miriad as a useful radio astronomy package?**

  Yes. The overwhelming response of users is that Miriad has been and is currently a highly successful radio astronomy package, specifically for observations using the Compact Array.

- **Could the review panel comment on Compact Array upgrades that they see as essential for Miriad to support in the near future?**

  The review panel identified the CABB upgrade as the highest priority Compact Array project for which Miriad support is critical in the near-term.

- **Is there other important functionality missing in Miriad?**

  The review panel received many submissions from many users (emailed and verbal). The following list should not be taken as complete, given the time available for the review, but is sufficient to illustrate the fact that there are many minor developments that need to be addressed in Miriad:

  - Completion of port to 64-bit machines;
  - Solution to XMTV 24 bit display problems;
  - Inclusion of *w*-projection imaging algorithms;
  - Improved coordinate handling;
  - Inclusion of better methods for rotation measure calculation;
  - Ability to use calibration sources with structure in MFCAL and GPCAL;
  - More consistent and more complete use of PGPLOT functionality in interactive plotting tasks;
  - Ability to load data from Australian Long Baseline Array (new VLBI capabilities; circular polarisations).

- **Given the transition to pipelines based on the AIPS++ toolkit for future instruments such as the xNTD and the Atacama Large Millimeter Array (ALMA), what role do users see for long-term development in Miriad?**

  The review panel felt that the base level answer to this question is that as long as the Compact Array is operational, Miriad should be the primary data reduction package.

- **Given competing resources, can the review panel comment on attempts to merge US and Australian Miriad?**

  The review panel did not see a strong argument to reunify Australian and US versions of Miriad, recognising that there may be benefits for Compact Array users, but also recognising that there were likely to be very significant overheads in a reunification process.

The ATNF is drawing up a plan to address these recommendations, taking into account the impending needs of CABB in particular. Meanwhile, we have asked Mark Calabretta to take responsibility for maintenance of the code base following the departure of Bob Sault. He has made excellent progress in easing the installation and upkeep of Miriad on various platforms. His report follows.

Dave McConnell and Tim Cornwell
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Miriad status report

Miriad code management has been revamped recently. New features aim to facilitate the installation of Miriad outside the ATNF, or on a laptop or home computer:

- Now supported for Mac OS X (Darwin), both PowerPC and Intel. (Consequently, the RPFITS library is now also supported for these platforms.)
- Binary installation kits are provided for solaris, linux (32- and 64-bit) and Darwin (PowerPC and Intel). The statically-linked executables are self-contained with respect to third-party libraries (RPFITS, PGPLOT, etc.), so there is no need to install these separately.
- For those systems where a binary installation is not provided, or where code development is intended, installation of Miriad from source code is now based on the standard GNU configure/make model.
- Installation instructions have been rewritten, and the Miriad homepage and related manuals revised.
- A new update procedure, mirsync, allows those with ssh access to ATNF's computer network to update their Miriad installation easily. mirimport is still supported for updating a source-code installation.
- ATNF's Miriad installation has been moved to the directory */nfs/atapplic*. The observatories now mirror the Epping system each day via the normal rdist/rsync mechanism.

For Miriad programmers (particularly with future CABB development in mind):

- All Miriad source code is now maintained within RCS, thus allowing code changes to be tracked line-by-line.
- The compile scripts (mircadd, mirclnk, etc.) have been replaced by a system of GNU makefiles.
- The makefiles support development within a programmer's private workspace (so-called "sandbox").
- The makefiles perform a full dependence analysis, including that of executables on object library modules, thus ensuring that whenever a low-level include file or subroutine is modified everything that uses it is recompiled.

The new system answers many of the needs expressed by Miriad users since I took over Miriad management following Bob Sault's departure last March — over 500 emails have accumulated in my Miriad folder since then! Many queries originated from overseas users, frequently relating to Mac OS X. There has also been a steady flow of bug fixes and requests for code enhancements. Bob still maintains an active interest and assists with more esoteric questions.

On a related matter, a new mailing list, "atnf-data-reduction", has been set up for announcements and discussion relating to all offline data reduction software used within the ATNF, including Miriad; see *www.atnf.csiro.au/lists/*.

Mark Calabretta
(Mark.Calabretta@csiro.au)

ATNF distinguished visitors

The ATNF has recently said farewell to a few long-term distinguished visitors. Jayaram Chengalur (NCRA, India) departed in December 2006, as did Bill Coles (UCSD, USA). We are fortunate to still have two long-term visitors: Andrea Lommen (Franklin & Marshall College, USA), who will stay at the ATNF until the end of June 2007, and Ger van Diepen (ASTRON, The Netherlands), who will stay until August 2007. We are expecting a number of shorter-term visitors over the next few months. Martin Cohen (Berkeley) will visit twice in the coming year, once in April and again in August. Phil Kronberg (LANL / U Toronto) will be visiting ATNF and the University of Sydney for three months from September 2007 and again for three months next year.

We are also looking forward to hosting several short-term visitors, including Andrei Sobolev (Ural State University, Russia) and Georgij Rudnitskij (Sternberg Astronomical Institute, Russia), in conjunction with IAU Symposium 242, the "Astro-physical masers" meeting in Alice Springs in March.

Details of the ATNF visitor program can be found at the URL *www.atnf.csiro.au/people/distinguished_visitors.html*. Visits are partially funded by the Distinguished Visitors and the Federation Fellows programs.

Naomi McClure-Griffiths (on behalf of the Distinguished Visitors Committee)
(Naomi.McClure-Griffiths@csiro.au)

Graduate student program

I would like to officially welcome the following students into the ATNF co-supervision program:

- Emma Kirby (ANU) — "Turning the Time Arrow: The Evolutionary History of the Local Universe" with supervisors Dr Helmut Jerjen, Dr Erwin de Blok (both RSAA, ANU) and Dr Bärbel Koribalski (ATNF).
- Rebecca McFadden (University of Melbourne) — "Radio Cerenkov Emission from UHE Neutrinos" with supervisors Profs Bill Moran, Rachel Webster, Peter Farrell (all University of Melbourne) and Prof Ron Ekers (ATNF).
- Attila Popping (University of Groningen) — "Kinematic Imaging of the Cosmic HI Web" with supervisors Dr Thijs van der Hulst (Kapteyn Astronomical Institute) and Dr Robert Braun (ATNF).

Congratulations to Antoine Bouchard on the successful submission of his Australian National University PhD thesis on "The interstellar medium and evolution of dwarf galaxies in nearby groups", and to Rachel Deacon on the successful submission of her University of Sydney PhD thesis on "Magnetic fields and companion stars: Behind the shaping of planetary nebulae".

Antoine is now in Lyon (France), at the Centre de Recherche Astrophysique de Lyon (CRAL), Universite Claude-Bernard.

Bärbel Koribalski
Graduate Student Convener
(Baerbel.Koribalski@csiro.au)

AT Users Committee meeting report

This is my first report since taking over as ATUC Chair in June 2006, and I would like to record ATUC's thanks to the outgoing Chair, Dr Steven Tingay, and Secretary, Dr Jim Lovell, for all their hard work over the past three years. We welcome Dr Michael Dahlem (ATNF) as the new ATUC Secretary.

A full report on the ATUC meetings held in June and October 2006 can be found on the ATUC website (*www.atnf.csiro.au/management/atuc*), but a couple of points are worth highlighting here:

- The next ATUC meeting will take place in Sydney from 30 April to 2 May 2007, and will include a one-day Australia Telescope science symposium on Monday 30 April. This is a reinstatement of the annual symposium series which was held regularly until 2004 (often as a joint AAO/ATNF symposium), at which AT users are invited to present science results from the national facility telescopes. More details, and a call for papers, will be posted on the ATNF website soon, but please keep this date free in your diaries.

- Both 12-mm and 3-mm observations with the Compact Array remain feasible (particularly at night-time) outside the nominal winter observing season. A recent paper by Middelberg, Sault & Kesteven (PASA 2007, in press; see astro-ph/0609765) analyses several years of data from the Compact Array Seeing Monitor and shows that in terms of atmospheric phase stability, nights in spring, summer and autumn are as good as or better than daytime observing in winter. Observers may wish to take this information into account when planning their millimetre observing proposals.

If you have comments on any of the issues discussed in the full ATUC reports, or suggestions for topics to be discussed at the next ATUC meeting, please feel free to talk to me or your local ATUC member (listed on the ATUC webpage). Comments and feedback can also be submitted online via the feedback form on the ATUC webpage at the URL: *www.atnf.csiro.au/management/atuc/atuc_feedback.html*, and comments from overseas users of the ATNF facilities are also welcome.

Elaine Sadler
ATUC Chair
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Articles

Optical and radio survey of Southern Compact Groups of galaxies

Summary

Compact groups of galaxies are outstanding laboratories for studies of the influence of gravitational interactions on the chemical and dynamical evolution of galaxies. Gravitational interactions are likely the most efficient way of removing gas from galaxies into intergalactic space, especially in dense, low velocity dispersion environments. The Southern Compact Groups (SCGs) sample is a complete sample of compact groups of galaxies described by Iovino (2002), based on objective, automated selection criteria, ideal for studies of the dynamical and chemical evolution of their member galaxies. The goals of our optical and radio survey are to assess how important galaxy interactions are in triggering star formation and Active Galactic Nucleus (AGN) activity and therefore the production of heavy elements and energy in galaxies and whether tidal disturbances then lead to the removal of chemically enriched matter from the interacting galaxies. In addition, this project serves as a test of whether elliptical galaxies are indeed, as envisaged in the hierarchical clustering scheme, the end products of major mergers of smaller, potentially gas-rich disk galaxies.

Optical survey

Based on automated search criteria, 121 candidate southern compact groups were identified on COSMOS digitised plates by Iovino (2002). Of these, a complete subsample of 50 SCGs were re-observed at optical and a small number at near-infrared (NIR) wavelengths with various telescopes of the European Southern Observatory (ESO).

Optical spectroscopy was employed to establish group membership of individual galaxies and thereby to validate the status of a candidate as a compact group based on the initial selection criteria. Spectra of the nuclear regions are used to obtain quantitative information on the type of nuclear activity (starburst vs. AGN) and, in the case of starbursts, to measure nuclear star formation rates.

Optical/NIR imaging was performed to obtain a database based on which model fits could be performed to morphologically decompose the galaxies into their various constituents and to search for deviations from regular shapes that might hint at the presence of external disturbances caused by interactions.

Compact Array HI and radio continuum observations

A second powerful tool for searches of signs of galaxy disturbances and/or interactions is HI line imaging. A search of the Compact Array online data archive revealed that six SCGs from the subsample of 50 had previously been observed in both the HI line and 1.34 GHz continuum emission, leading to a small pilot study.

HI is used as a tracer of the distribution and kinematics of neutral gas in the member galaxies of SCGs and to search for signs of disturbances and the possible existence of an intra-group medium. Figure 1 displays an optical image of SCG0018-4854 (left) and an overlay of an Compact Array HI total intensity map on a DSS-2 red image (right). Based on their HI distributions one can establish the current dynamical states of groups and compare these with the evolutionary scenario proposed by Verdes-Montenegro et al. (2001). Many different morphological and kinematical parameters of the SCGs and of their individual member galaxies could be determined that had previously been unknown. The HI properties of one other SCG, the “Grus quartet”, were presented separately by Dahlem (2005).

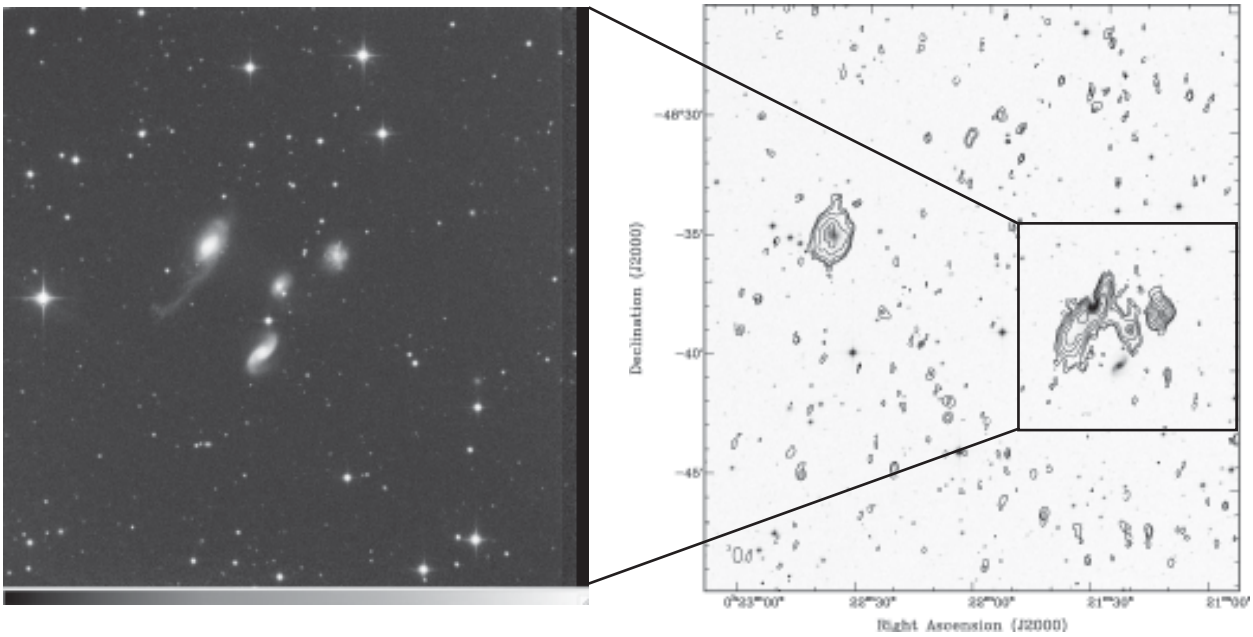

Figure 1: Optical image (left) and HI total intensity contours on a DSS-2 red image (right) of SCG0018-4854. Both show signs of disturbance affecting the morphology of the dominant spiral, NGC 92. The group is classified by us as being in a late evolutionary phase (3b), following the scheme outlined by Verdes-Montenegro et al. (2001).

Total radio continuum flux densities, after exclusion of AGNs, are a measure of the total star formation rates in galaxies in these groups, which can be compared directly with their dynamical state. In line with previous results (e.g., Hummel et al. 1990), the nuclear regions of interacting galaxies are found to be on average more active than those in the field. The results of this pilot study of six SCGs have been summarised by Pompei, Dahlem, & Iovino (2007, A&A, submitted).

Other observations

For some objects, in particular SCGs dominated by early-type galaxies, but also for some dominated by spirals, X-ray observations were obtained with the XMM-Newton satellite to study the X-ray emission from member galaxies and to check for the presence of a hot intra-group medium.

On-going large project

The success of the initial Compact Array archival pilot study prompted the submission of a new, dedicated observing proposal. New Compact Array HI and radio continuum observations conducted by us form part of a multi-wavelength observing campaign aiming at addressing the points raised above based on a larger sample. A total of 16 objects have been observed with the Compact Array so far and work on the recently obtained datasets is underway.

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Michael Dahlem (ATNF Narrabri), Emanuela Pompei (ESO, Chile) and Angela Iovino (INAF – Osservatorio Astronomico di Brera, Italy) (Michael.Dahlem@csiro.au)

Centaurus A — a long overdue synthesis imaging survey

"Surely it's been done" is the typical response I get when I mention that we are going to make an aperture synthesis mosaic of our closest radio galaxy, Centaurus A. But, of course, it really has not ever been done. We are now a quarter of the way through our imaging program and, I am pleased to report, it is by all accounts so-far-so-good. With only half of the required sensitivity, and (more importantly) only a quarter of the *uv*-coverage, we have a very long road ahead. But the results from the first of the four 750 metre array configurations look promising indeed.

Centaurus A is by far the closest active supermassive black hole in the Universe, and has radio jet/lobe structures that span about 4 x 9 degrees on the sky. Figure 1 shows a greyscale image of NGC 5128, the elliptical galaxy that hosts the radio source Centaurus A, overlaid with Very Large Array (VLA) 1.4-GHz radio continuum contours of the inner jets. These inner jets amount to less than 1% of the entire radio structure. Figure 2 shows the full extent of the radio emission at 1.4 GHz, mapped with the Parkes telescope well over a decade ago (courtesy Norbert Junkes). The contours of the inner radio jets shown in Figure 1 are also displayed in Figure 2. So, why has Centaurus A never been fully imaged with an aperture synthesis telescope? Probably because the large angular size and the low surface brightness of the outer lobes make this project daunting, expensive in time and, up until recently, lacking in sophisticated software to deal with the high dynamic range and large field-of-view. The Compact Array really is the only array for the job, and finally it is being done!

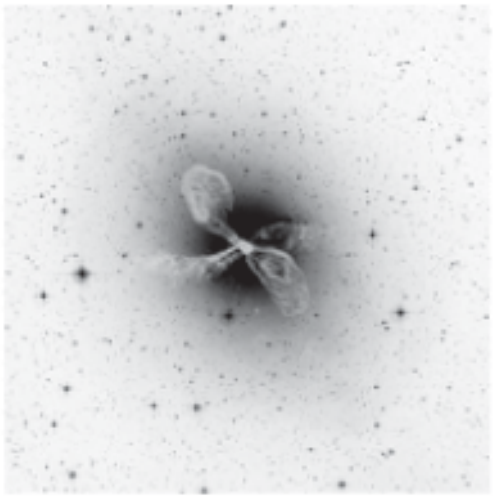

Figure 1: Greyscale optical image (from the Digitised Sky Survey) of NGC 5128, the nearby elliptical galaxy that hosts the radio source Centaurus A. VLA 1.4-GHz radio continuum contours (Clarke, Burns & Norman, 1992, ApJ, 395, 444) are overlaid on the optical image. These radio jets represent less than 1% of the total extent of the radio structure of Centaurus A.

To date, the large-scale structure of Centaurus A is known only from the Parkes single dish images. But with such low resolution (~5 arcminutes at 4.8 GHz), it was not possible to study the lobe structure in much detail. The images we are making with the Compact Array will have a spatial resolution of about 600 parsecs, similar to the spatial resolution of the famous Virgo A (M87) and Cygnus A images made with the VLA. But the Centaurus A image will have at least four times the number of resolution elements, because the radio source is physically so much larger than both Virgo A (80 kpc) and Cygnus A (140 kpc). This essentially means that Centaurus A's radio lobe structure can be studied in more detail than is possible for any other radio galaxy!

The science goals of this imaging program encompass a wide range of astrophysics. Here I will mention the goals that our team are actively pursuing. Firstly, we will explore elements of feedback (i.e. the interaction, influence and impact) between the radio plasma and physical processes in the intergalactic medium (IGM), like shocks, ionised filaments, star formation and hot gas bubbles. The second science goal is to exploit the strong polarised emission of Centaurus A as a background screen to probe the magnetic fields of foreground sources (galaxies, high velocity clouds, our Galaxy) and as a foreground screen to investigate the Faraday rotation caused by the radio lobes and the IGM into which the lobes are expanding, using lines of sight to the hundreds of polarised background sources.

Commencing on 20 December 2006, we began the first set of observations with the Compact Array at 1.4 GHz to mosaic the full area shown in Figure 2. We cover the field with about 500 pointings, in mosaic imaging mode, observed as blocks of 25 pointings per day; Figure 3 shows the Compact Array pointings

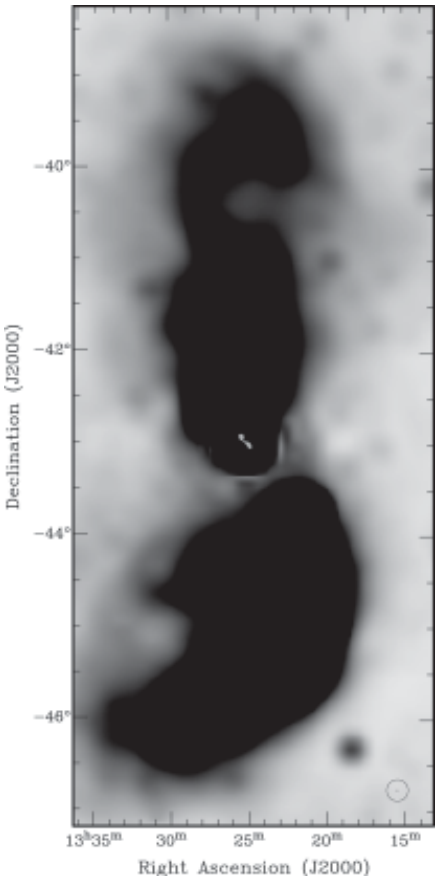

Figure 2: Parkes 1.4 GHz greyscale image (courtesy of Norbert Junkes) overlaid with the same VLA contours as in Figure 1. The bottom right corner shows the angular resolution of this Parkes image (circle) with the Compact Array resolution from our current imaging program inset with a tiny ellipse.

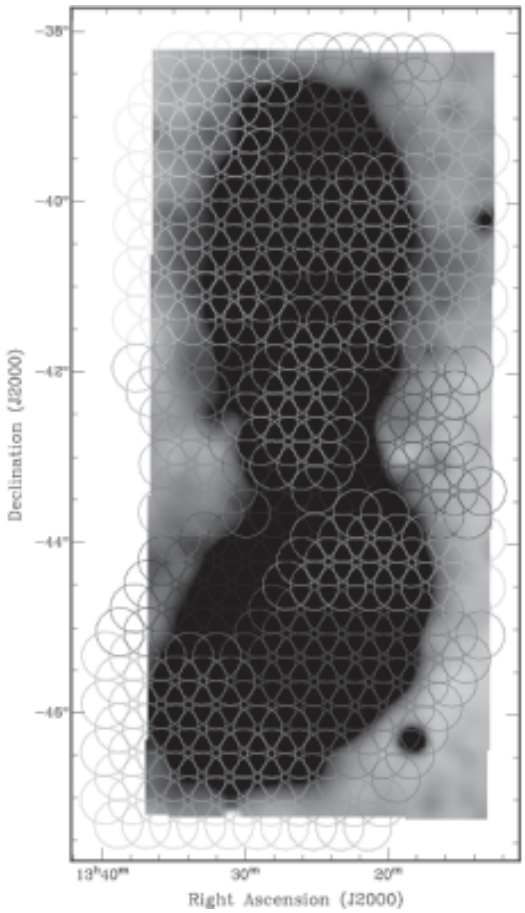

Figure 3: Parkes 1.4 GHz greyscale image (courtesy of Norbert Junkes) saturated to show the most diffuse large scale emission, overlaid with the Compact Array mosaic pointings used for this imaging survey. Each group corresponds to a single 12 hour observation.

overlaid on the Parkes 1.4 GHz continuum image. The complicated structure associated with this source means that *uv*-coverage is of paramount importance, and we therefore require all four 750 metre array configurations. The December 2006 observations were done in 750A and we will be observing in 750D configuration at the end of February 2007.

We are, at the time of writing, a quarter of the way through our observations and a first look at the 750A data shows promising results. The large-scale polarised emission seen in the Parkes images is already evident, although a much more densely sampled *uv*-plane is crucial to successfully image these diffuse, complicated lobe structures. In addition, there are several hundred background point sources in the field that are strong enough to probe the Faraday rotation in the radio lobes and the intergalactic medium into which the lobes are expanding. Our biggest hurdle is dealing with the strong sidelobes from the 200 Jy nucleus. But with Tim Cornwell on the case, implementing his multi-scale CLEAN and peeling algorithms, we are confident that this project will be a success!

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Ilana Klamer (on behalf of the whole team; in alphabetical order):
Joss Bland-Hawthorn (AAO), Tim Cornwell (ATNF), Ron Ekers (ATNF), Melanie Johnston-Hollitt (UTas), Ilana Klamer (ATNF), Enno Middelberg (ATNF), Ray Norris (ATNF), Jürgen Ott (NRAO) (Ilana.Klamer@csiro.au)

Continued from page 1

Supernova 1987A: 20 years old and still growing stronger!

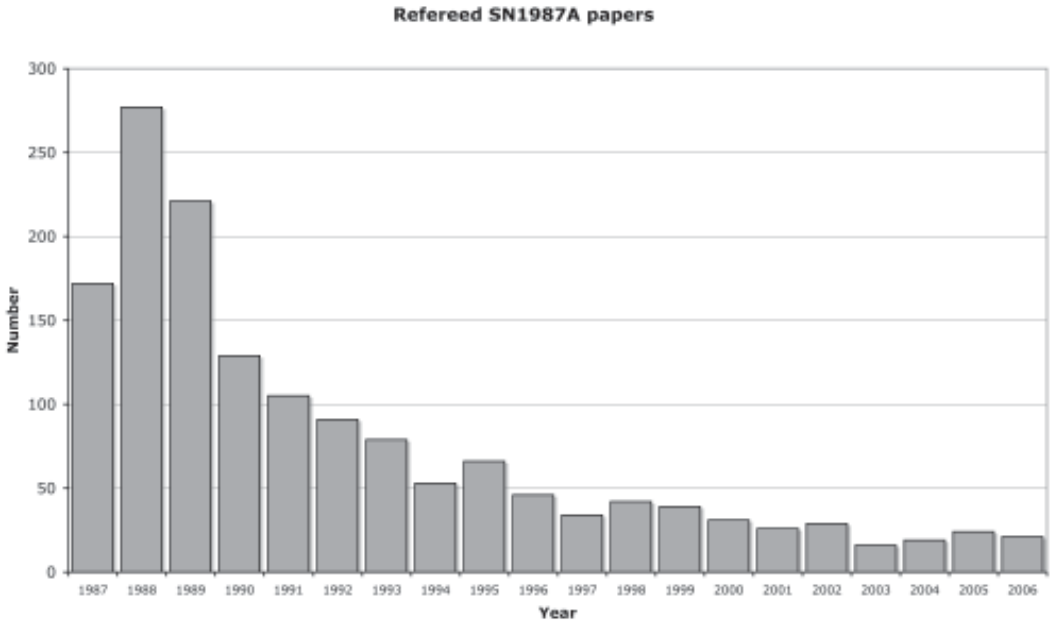

Figure 1: Number of refereed astronomy and physics papers mentioning supernova "1987A" in their title or abstract published each year since 1987. Data from NASA's Astrophysical Data System.

that the initial shock velocity was in excess of 19,000 km/s, consistent with contemporaneous optical spectroscopy.

Figure 1 shows that 1,522 refereed astronomy and physics papers, with 32,277 citations to them, have been published on SN1987A, according to the NASA Astrophysical Data System! Interestingly, the publication rate has hovered around the 20–30 mark for the last decade. Moreover, two major conferences at the Aspen Center for Physics in Colorado and in Hawai'i will shortly be marking the 20th anniversary of the explosion, each with a wide-ranging set of talks on the physics of supernovae and Gamma-ray bursts (GRBs). Why the continued interest? The answer lies in the high-density environment around the expanding shock wave which continues to create a firework display in all wavebands from the radio to the X-ray regime. Fourteen years of Compact Array imaging data, shows that, rather than fading after a few weeks as has been seen in all other radio supernovae, SN1987A has considerably brightened in the intervening years, as can be seen in the various panels of the front cover image.

The reason for the brightening in the radio and other regimes relates to the extremely high densities in the pre-existing circumstellar medium. This medium is most visible in the Hubble image shown in the inset of the front cover image. Unlike the radio image, the Hubble image mainly shows the pre-existing medium excited by the rapidly engulfing shock wave. However, detailed understanding of the formation of this ring-like structure is still absent, with recent work by Nathan Smith on similar structures around Luminous Blue Variable stars in our own Galaxy calling into question the usual evolutionary scenario which invokes a transition of the progenitor of SN1987A from a red supergiant to a blue supergiant in the recent past.

The unusual brightening of SN1987A and the fact that the radio morphology is no longer due to interaction with an inverse square-law stellar wind, means that it is often regarded as a supernova remnant (SNR) in its early phase, rather than a radio supernova. The gradual flattening of the radio spectral index from an initial value of –1.0 ($S \propto \nu^{\alpha}$) to its current value of –0.7, which is closer to that of canonical SNRs, confirms this.

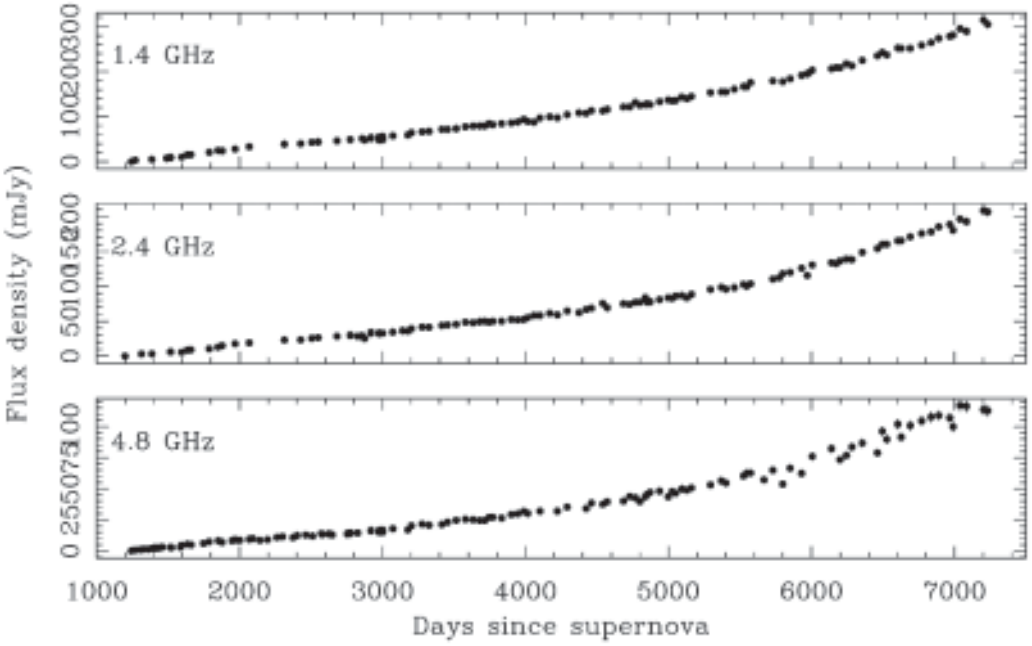

Figure 2: Seventeen years of Compact Array monitoring of SN1987A up to day 7231 (11 December 2006) showing that the flux density is not only increasing at all frequencies, but that the rate of change of flux density is also increasing.

Figure 2 shows that the flux density of SN1987A has now exceeded 300 mJy at 1.4 GHz, and, moreover, that the rate of change of its flux density is also increasing, but not quite at the same rate as Chandra observations of the 1 keV X-ray luminosity have suggested in recent years (Park et al. 2006). Future predictions of the flux evolution are fraught with uncertainty — partly due to poor detailed knowledge of the cosmic ray acceleration mechanism and magnetic field evolution — but mainly due to the poorly understood circumstellar density profile. The continuing interaction of the shock front with the circumstellar medium provides the power source for the generation of the synchrotron radiation responsible for the radio brightness.

Recent observations have resulted in images of even higher resolution compared to the mosaic shown on the front cover (Manchester et al. 2005) and have resulted in the first detection at 3 mm using the upgraded Compact Array. What does the future hold? Low frequency observations with the more sensitive eVLBI array will be useful in establishing the variation of spatial structure across an order of magnitude in frequency, which will help us better understand the acceleration mechanisms. The detection of a pulsar would be extremely important on a number of fronts — stellar evolution theories are divided between a neutron star and a black hole end-point for the remnant of SN1987A; and pulsar birth periods currently remain poorly understood. Finally, will SN1987A continue to brighten in the radio regime and perhaps one day rival that of the neighbouring giant HII region, 30 Doradus? Probably unlikely at this stage, but SN1987A has produced many surprises in the last 20 years, and more can be expected!

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Regular items

ATNF outreach

2006 Summer Vacation Program

The 2006 ATNF Summer Vacation Program commenced in early December and ended in mid-February 2007. Five of the six students came from across Australia — Adelaide, Townsville, Brisbane, and Sydney, and one from the UK (Manchester). Each student spent ten weeks working on a project under the supervision of ATNF staff. Three students, Dilini De Silva, James McGeachin and Kate Randall, were based at Narrabri while three, Sheila Kanani, Chris Lustri and Tony Whelan, were based at Marsfield. Projects included engineering and xNTD development, pulsar astrophysics and studying intra-day variability in radio sources.

Photo: Michael Dahlem

2006 Summer vacation scholars at Narrabri (from left to right), front: Sheila Kanani, Kate Randall, Dilini De Silva, back: Tony Whelan, James McGeachin, Chris Lustri.

An important part of the Summer Vacation Program is the observing trip to Narrabri to use the Compact Array. Erik Muller's talks on radio astronomy and observing techniques prepared the students, and Erik also helped with observing support at Narrabri. The students split into two groups for the observing sessions and devised their own observing projects. The observing was scheduled over a 24-hour period, so they experienced the joys of all-night observing sessions.

The program concluded with a half-day symposium and lunch in February at Marsfield. The vacation students presented the results of their projects in a set of excellent presentations and confidently fielded questions from the audience.

Robert Hollow
ATNF Education Officer and Summer Vacation Program coordinator
(Robert.Hollow@csiro.au)

My experience as an international summer vacation scholar

My time here at the ATNF in Marsfield has honestly been ten of the best weeks of my life. I have learnt a lot about my project, about Australia and most importantly, about myself. I have gained skills that I will keep for life and made friends from the other side of the planet. The ATNF feels more like an extended family than a work place and everyone has done their best to make me feel right at home in sunny Sydney. Living in the Marsfield Lodge was a blessing; I would recommend it over the Hilton any day!

Work never felt like work! I often relished the fact that it was Monday morning, excited about the

prospect of analysing new data that could lead to amazing discoveries. My project was loosely titled "Detecting Earth-mass planets around pulsars" and I spent time using codes that looked for periodicities in pulsar residuals.

One of the highlights of the scholarship was visiting, and in particular having observing time at, the Compact Array in Narrabri. Going through the processes that a real astronomer has to do on a regular basis was one of the biggest learning curves I encountered. The twelve hours of observing (from midnight to midday!) and the fourteen hours amassed on the train also did wonders for getting to know my fellow students!

I have done summer placements before, but none ever quite like this one. For one thing, when the Aussies say "summer" they mean "SUMMER"! Having the opportunity to travel to another country was fantastic, too. I had never been to Australia before and living in Sydney meant I felt like a true Sydney-sider; from scuba diving with sharks to camping out at the Opera House from 10.00 am on New Years Eve to secure a good view of the fireworks!

The success of this placement has cemented my passion for astrophysics, and radio-astronomy, and I am applying for PhDs as we speak. One of the PhDs I am applying for links directly to my project here — which proves how life-changing the scholarship has been!

It is imperative that I mention the driving force behind the success of this placement and that is unquestionably the people I have met. From the other students, to my supervisor, to every single person I have spoken to at the ATNF I always felt like my questions were good questions, never failed to find someone to help me when I was stuck and was always being asked to dinner by the staff here! Even on Christmas day, with my family on the other side of the planet, I didn't even think about feeling lonely because I was so well looked after.

Finally, I must talk about the only downside I encountered while being here. Two words: The Ashes. When Australia beat the UK with a thunderous 5 – 0 I had to hide under my desk for fear of being made to cross over to the dark side and support Australia. If there is one thing the ATNF love more than radio-astronomy, it's cricket!

My thanks go out to everyone at the ATNF, with special mentions to George Hobbs, Shaun Amy, Rob Hollow, Eric Muller, Vicki Drazenovic and Ella Kachwalla, and the other summer students for their support and friendship while I was here.

Sheila Kanani
ATNF summer vacation student 2006/2007

Workshop sessions at State Science Teacher conferences

The ATNF Education Officer, Rob Hollow, ran several workshop sessions at the Science Teacher Association of Victoria's Annual Conference at La Trobe University in November 2006 and the Science Teachers' Association of NSW Annual Conference at the University of NSW in December. Sessions covered using astronomy across the electromagnetic spectrum and how to effectively model and teach day and night and lunar phases in the classroom. The ATNF Director, Dr Brian Boyle, was an invited keynote speaker at the NSW conference. His talk covered his life and early influences in science, some of his moments in research and the future of astronomy in Australia. It was extremely well received and prompted many questions from the science teachers.

Robert Hollow
ATNF Education Officer and Summer Vacation Program coordinator
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Compact Array and Mopra report

Noteworthy events

A transit of Mercury across the Sun's disk occurred last November and, as part of our outreach program, John Smith (visiting from Parkes) and Jo Houldsworth set up an optical telescope in town for viewing. The day started with almost complete cloud cover, but good viewing conditions were obtained as the morning wore on. Nigel Prestage, of the Ionospheric Prediction Service, kindly provided staff and observers on-site with a similar service.

Photo: Michael Dahlem

John Smith with Phil Edwards and members of the public at the transit of Mercury viewing in Narrabri.

Cloud cover also prevented views of comet McNaught as it first became visible after sunset in January 2007. After several frustrating evenings, however, we were rewarded with stunning views of the comet. A photo taken by Dion Lewis, duty astronomer for the week, of the comet with antenna 5 in the foreground appears on the ABC website */www.abc.net.au/science/scribblygum/yourphotos/summer07/sky/* (see next page).

Narrabri systems and developments

Both the C1621 and C1624 observing teams encountered problems with radio frequency interference (RFI) over the Christmas/New Year period. The 20-cm band interference, at 1448.5 MHz, was determined to be coming from a transmitter on Mt Kaputar. This frequency is within the 1427 – 1535 MHz terrestrial microwave link band. The RFI at 13 cm was intermittent and took a little longer to track down, but two independent lines of enquiry determined that it arose from 2492-MHz transmissions from Globalstar satellites: a global web search found the most accessible spectral information about Globalstar was on Daniel Mitchell's ATNF web pages! At the same time, Tim Cornwell was using the program Starry Night Pro to confirm that the RFI was strongest when Globalstar satellites passed close to the Compact Array's field of view. Both sources of RFI are relatively narrow-band (for 128 MHz bandwidths) and so can be excised without a catastrophic loss in sensitivity.

Satellite transmissions were put to use for productive purposes in November, when the Optus B-2 30-GHz beacon used for the Compact Array seeing monitor was used for holographic measurements of the surface of antenna 6 (CA06). As reported in the last issue, the prototype 7-mm receiver was installed on CA06 during the split array period in August. The VLBI group kindly agreed to do without CA06 during November's VLBI week, enabling Mike Kesteven to

lead several rounds of holographic measurements and panel and subreflector adjustments. As a result, the antenna surface accuracy improved from an rms of 0.32 mm to 0.20 mm.

A team from NASA's Jet Propulsion Laboratory and the Canberra Deep Space Communication Complex visited in January to install equipment in readiness for 32-GHz spacecraft tracking with the Compact Array. Tests at 3 cm and 13 cm of several satellites confirmed the array's capability to track and phase-up on a satellite signal.

Summer vacation program

As reported on page 16 of this issue, the Observatory hosted three students over the summer period. Dilini, James and Kate all made excellent progress on their respective projects and were welcome visitors over the summer period. One immediate outcome of the vacation program has been the return of Dilini to Narrabri under the Griffith University Industrial Affiliates Program (IAP).

Mopra developments

Mopra observing continued into December this year, with Erik Muller stepping into the breach to provide assistance to observers with all our other Mopra experts having left! Erik was back in January as part of a target-of-opportunity team attempting to detect spectral line emissions from Comet 2006 P1 (McNaught). Observing at 3 mm, close to the sun, in the middle of summer, is challenging enough, but Erik also was able to identify problems with the ephemeris tracking software, which were quickly fixed thanks to the efforts of Mike Kesteven and Mark Wieringa.

Remote Observing

During the October 2006 semester we have been trialling a relaxation of the requirements for Compact Array remote observing. It is still the case that remote observing will only be granted to astronomers who have observed with the Compact Array in person at Narrabri within the previous 12 months,

Photo: Dion Lewis

Comet McNaught with Compact Array antenna 5 in the foreground, on the night of 19 January 2007.

however other restrictions on the amount of remote observing within any given time interval have been relaxed for the duration of this semester. This trial is now being assessed, and the outcome will be announced on the Compact Array web pages and in the next *ATNF News*.

Site infrastructure

Observers to the site will not fail to notice the changes to the observers area. The old upstairs computer room, which had defaulted to part library shelves and part storage area, has been opened up to create a more open and accessible area.

A heavy downpour in early December 2006 resulted in several ceiling panels in the lodge breezeway falling in. Whilst we welcome all the rainfall we can get, we would certainly prefer that it doesn't all fall in such a short space of time!

Elsewhere on site, a grant from the Namoi Catchment Management Authority is enabling the fencing off and revegetation of an area of the creek that runs between the 3-km east-west track and SUSI. This creek was diverted with the aid of some major earthworks during the construction of the Compact Array, and this project is helping to rehabilitate the affected area and restore it to its natural state.

Phil Edwards
Officer-in-Charge, Narrabri Observatory
(Philip.Edwards@csiro.au)

Parkes observatory report

Operations

Operations in the last five months have been generally very smooth, with the sole exception of strong winds throughout much of December and January. This has become a very strong annual pattern in recent years.

In particular there has been no recurrence of the problems with the zenith drives experienced in September 2006. The time lost over the last five months is dominated entirely by high winds, at 5.2% of all time lost, with only 0.5% lost to faults.

The GASS (Galactic All-sky Survey) completed observations at Parkes in November, after a two-year observing program. We all look forward to seeing the final images.

Pilot observations for a new survey of continuum polarisation at a wavelength of 13 cm, dubbed S-PASS (S-Band Polarization All Sky Survey) commenced in January. This observing program will scan the sky with the 64-metre telescope at a slew rate of 15 degrees per minute in azimuth, the fastest scanning rate for a large survey that has been employed at Parkes for some time (or perhaps ever). The survey will certainly give the new azimuth gears a good workout when it commences in earnest.

Duplication of the entire Parkes 20-cm Galactic Pulsar Survey (P268) database is underway. It is expected that a complete copy of this approximately five-Terabyte database at Jodrell Bank will be available at Parkes later this year.

November-December shutdown

The 64-metre telescope was off the air for three weeks from 28 November 2006 for a long-planned refurbishment of the azimuth gearboxes. Essentially all moving parts in these gearboxes, most of them 45 years old, were replaced with new components. This work was successfully completed on time, and the new gearboxes are being closely monitored during their running-in. This work was carried out with assistance from Brian Wilcockson and Steve Broadhurst from Marsfield, Tim Wilson from Narrabri and of course Jon Crocker from Parkes.

A second major work in the shutdown was the removal of the 20-cm multibeam package for the second phase of its refurbishment. The removal went very smoothly and the receiver is currently disassembled in the receiver laboratory as the new low noise amplifiers (LNAs) are installed and other remedial works carried out. A fault was discovered in several of the ortho mode transducers (OMTs) which is strongly suspected of causing the microphonic instabilities observed in several of the channels over recent years. There is some confidence that these defects, present since construction, have now been completely eliminated. The receiver is due to return to service in April or May 2007.

Some significant changes to the master equatorial (ME) drive system were implemented, including replacement of old (and mostly undocumented) drive electronics, and replacement of the long-serving master equatorial computer (PDP 11/20) with another 11/20 chassis of a type for which we have many more spare parts available. New software installed by Andrew Hunt has improved the tracking characteristics of the ME at the arcsecond level. Modifications to utilise the 13th bit of precision (8192 counts/turn) are mostly complete, and will be finalised at the next significant shutdown.

Other works carried out in the shutdown included installation of a new sliding receiver hatch on the focus cabin roof and installation of new airconditioning for the compressor room, both of which will improve the efficiency and reliability of operations. The first floor control room and stairs have been recarpeted and the "Olympic Village" has at last received its roof, giving its inhabitants rain- and sun-free access to the administration building.

Further upgrading of the mains switchgear was carried out to pave the way for full mains-synchronisation of the observatory generator supply. This project, to be completed later in the year, will allow seamless cutover from mains to generator — a great operational improvement.

Numerous other improvements around the site were also carried out during the shutdown period, all under the capable supervision of Barry Turner, our site-services manager.

Computing

Advantage was taken of the shutdown to install a new core switch (Cisco 6503) for the site, with work undertaken by Shaun Amy and Kan Tam. The new switch provides for an increase in the number of 1Gb/s connections to machines on-site, to take better advantage of the new broadband observatory links.

The shutdown was also used to repair optic fibres that had failed some months previously from rodent damage. This task was far from trivial, fully occupying a large team of cabling contractors for two days. The damage highlighted some inadequacies in the original cabling upgrade in 2004, which were unfailingly pinpointed by local wildlife. Brett Preisig was as usual on hand to ensure the operation ran smoothly and to specifications. Rodent counter-measures have been escalated on all fronts to prevent similar problems elsewhere on site.

Quarters

The final phase of the observers' Quarters upgrade was completed in November. This last stage comprised painting and repolishing of the timber in the enlarged dining area. The new facilities are a great credit to those involved in this project, all of whom are very glad to see it completed!

John Reynolds
Officer-in-Charge, Parkes Observatory
(John.Reynolds@csiro.au)

Time assignment information

Compact Array 7-mm installation

The new 7-mm receivers will be installed on the Compact Array antennas during the four-week shutdown starting on 26 March. A number of larger maintenance jobs on the antennas, such as UPS replacement and work on antenna drives, will also be undertaken during this period. Ilana Klamer has written new webpages for the 7-mm systems, which are available on the web at *www.atnf.csiro.au/observers/docs/7mm/*.

NASA tracking

Development of the new 7-mm receivers has been co-funded by NASA-JPL as a frequency of 32 GHz is being increasingly adopted for planetary missions. Following the installation and characterisation of the 7-mm receivers, the Compact Array will undertake a number of tracking demonstration and proficiency tests in readiness for use of the array as a NASA downlink station. The formal operations phase agreement between NASA and CSIRO is not yet finalised, but the understanding is that the array will be used, on average, for around 10 hours per week for tracking, with occasional periods of up to 50 hours per week. These will be included in the regular Compact Array scheduling process and appear in the Compact Array schedule as "NASA Tracking" blocks. There will also be provision for NASA to request use of the array at short notice for emergencies, which, should they arise, will have an impact on scheduled observations. As with any target-of-opportunity type observation, where possible, observations displaced by such an emergency will be rescheduled.

Observation tables

Part of the proposal process for the use of ATNF telescopes is the completion of an observations table. For the Compact Array and Mopra, this table has two uses: first, for the Time Assignment Committee (TAC) to see which sources will be observed, at which frequencies, and for how long, and second, to feed into the Compact Array and Mopra scheduling tool. Unfortunately, these two uses are not always complementary. Whereas the TAC will certainly be interested to learn you wish to observe 300 sources with a one minute integration on each, this information feeds into the scheduling tool as a request for 300 one-minute slots! So, to help your poor scheduler, it is extremely useful to have a statement in the proposal of exactly how you would like your observations scheduled, such as "four blocks of six hours duration scheduled anywhere between 07:30 and 15:30 LST." Such clear statements indicate to the TAC that you have carefully thought about the scheduling of your proposed observations, and make the scheduler's life significantly easier!

Large projects

The TAC has recently considered the submission of projects that require large amounts of observing time on the telescopes. Here we discuss recent time allocation statistics for the Compact Array, the Parkes radio telescope and the Mopra radio telescope, and we advise users of some changes to the proposal submission requirements for large projects on all ATNF facilities.

Time allocation statistics

Figures 1 and 2 show some time allocation statistics for the period from April 2006 to March 2007, corresponding to the two most recent semesters. Figure 1 shows the fraction of the total telescope time allocated plotted against time requested on the submitted proposals. For the Compact Array, 57% of time was allocated to proposals that requested up to 200 hours of observing time while 34% of time was allocated to all proposals that requested 400 hours or more. For the Parkes telescope, 42% of time was allocated to the proposals that requested up to 200 hours, with 47% allocated to proposals requesting 400 hours or more. For Mopra, 70% of time was allocated to proposals that requested less than 200 hours while 14% was allocated to proposals requesting 400 hours or more.

Large projects generally request observing time over several semesters. As the times requested each semester vary considerably, a better measure for the size of a project is the ***total*** observing time required for the project. This is the time required over all semesters from the start to the end of the project.

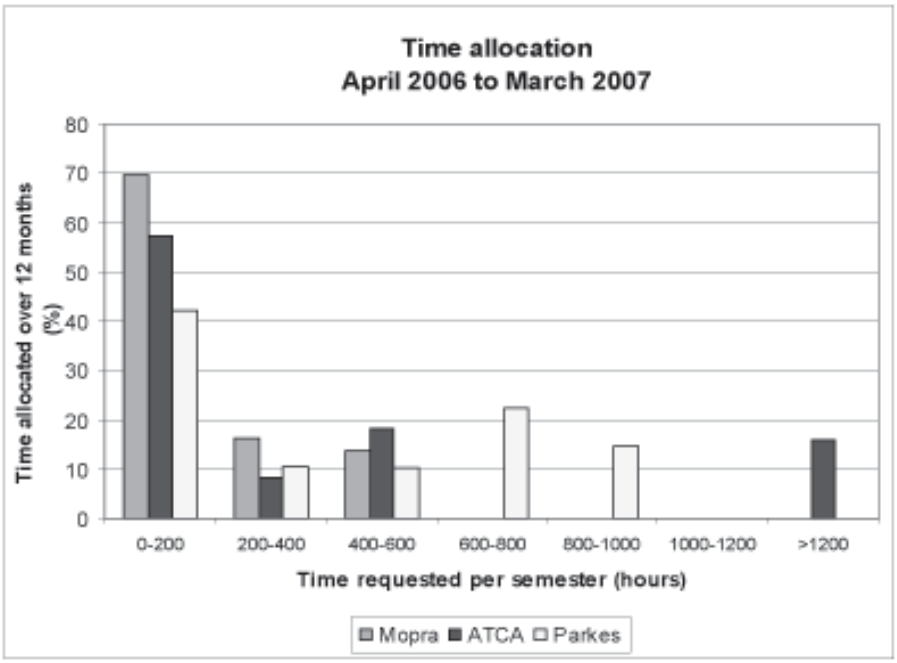

Figure 1: The percentage time allocated to Compact Array and Parkes proposals submitted between April 2006 and March 2007, plotted against the time requested on the proposals.

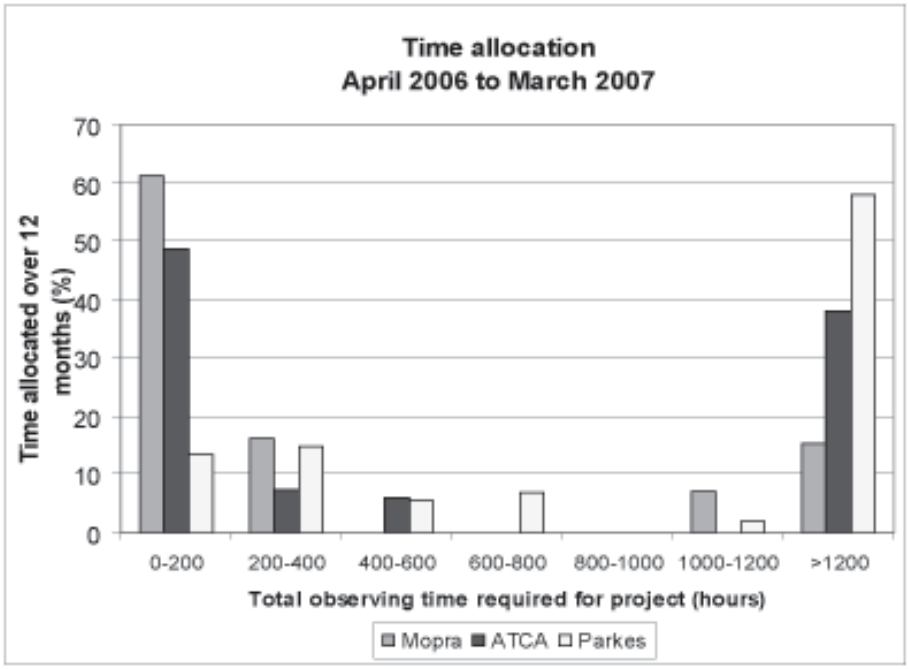

Figure 2: The percentage time allocated to Compact Array and Parkes proposals submitted between April 2006 and March 2007, plotted against the total time required for the projects.

Figure 2 shows the fraction of the total telescope time allocated plotted against total time required. From this distribution we find that for the Compact Array, 38% of time was allocated to projects with total time requirements of 400 hours or more while 23% of Mopra observing time was allocated to projects with the same requirements. For Parkes a large fraction of time is allocated to large projects, with 72% of time over the two semesters allocated to the projects requiring a total of 400 or more hours. It is evident that most large projects in fact request over 1000 hours. Some of these projects are scheduled over many years and require up to about 4500 hours of telescope time.

As a working definition, we define a large project as one which will require a total time allocation of 400 hours or more. For the Compact Array, eight of the

156 projects allocated time between April 2006 and March 2007 are included in this category, while for Parkes there were 13 of the 42 projects, and for Mopra there were four of the 40 projects.

Submission of proposals for large projects

We advise proposers that for the 2007 October observing semester (07OCTS) and onwards, all projects requesting a total of more than 400 hours of observing time on any ATNF telescope will fall into the category of large projects. For the initial proposal submission, large projects will have, in addition to the three-page limit for scientific justification, an additional two pages to be used for defining mandatory data analysis and timeline plans, data release plans, and a recommended public outreach plan. Additional figures supporting the scientific justification can be included within the two additional pages if desired.

Large projects can request time be allocated over several semesters, and if successful will usually be given continuing status to reflect this. A progress report (up to three pages) will then be required before further time is allocated. The TAC may choose to award reduced time allocations in cases where a small pilot study is required to show success before a large project can be judged on its scientific and technical merits.

For the ATNF there is no particular fraction of telescope time mandated for large projects. All proposals are judged and awarded time based on scientific merit. Proprietary periods for large projects are the same as for other projects, but early data release plans and waivers of proprietary periods are looked upon favourably.

Please note that unless already advised otherwise, proposals submitted for the 2007 April Observing Semester (07APRS) do not have continuing status. For information on submitting proposals for large projects please see the web page *www.atnf.csiro.au/observers/apply/large_projects.html*.

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ATNF publications list

Publication lists for papers which include ATNF data or ATNF authors are available on the web at *www.atnf.csiro.au/research/publications*. Please email any updates or corrections to this list to *Christine.vanderLeeuw@csiro.au.*

This list includes published refereed papers compiled since the October 2006 newsletter. Papers which include ATNF staff are indicated by an asterisk.

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