ATNF News

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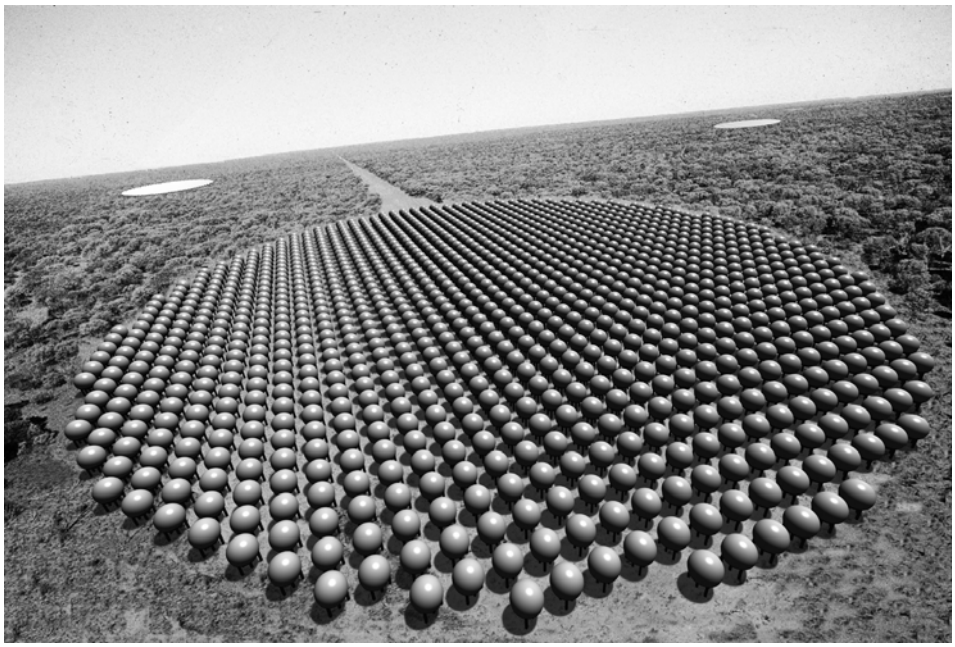
FEATURES IN THIS ISSUE

Major National Research Facilities funding for Australian astronomy

Ray Norris
ATNF Deputy Director



Artist's impression of one SKA antenna concept.

In the June 2001 issue of the ATNF News, I reported on the submission of a proposal to the Major National Research Facilities (MNRF) Program, a component of the Australian Government's "Backing Australia's Ability" statement, which was released earlier this year. The ATNF-led proposal involved a wide cross-section of the Australian astronomical community and had two main objectives:

1) To increase Australia's share in the International Gemini Telescopes in Hawaii and Chile from 5% to 10%, by building and providing new instruments for Gemini;

2) To develop enabling technologies for the Square Kilometre Array (SKA), in a way that enhances Australia's existing radio telescope facilities and reinforces Australia's bid as the prime location to host the SKA.

On 21 August 2001, the Minister for Industry, Science, and Resources, Senator Nick Minchin announced the allocation of $155 million under the MNRF Program to fifteen successful proposals. I'm very pleased to be able to report that the ATNF-led proposal was amongst those successful and was granted the largest single allocation, $23.5 million. Other successful

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Editorial

We have a packed issue this month as we near the end of the CSIRO 75th Anniversary year. As a tribute to this milestone we look at our past (see the historical articles by Wayne Orchiston and John Archer), our present (read about progress in the current ATCA MNRF upgrade), as well as to the future (great news on the success of the new MNRF proposal for Australian astronomy). We hope you will enjoy reading all the latest ATNF news here or on the web at *http://www.atnf.csiro.au/news/newsletter.*

The next issue the ATNF News will be distributed in February 2002. As always, contributions are welcome. Enjoy the Christmas and New Year holidays and see you in 2002.
The ATNF News production team – Steven Tingay, Jo Houldsworth and Jessica Chapman (newsletter@atnf.csiro.au)

Contents

News items

ATNF Director takes up Miller Professorship

Director of the ATNF, Prof Ron Ekers, is on leave from 1 July 2001 to 1 April 2002, to take up a prestigious Miller Professorship at the University of California Berkeley astronomy department. The visit is particularly timely because a privately funded radio telescope, The Allen Telescope Array, embracing a range of innovative new technologies is now being designed by the University of California and the SETI Institute.

Whilst on leave Prof Ekers will have some time to pursue neglected research activities and continue his involvement in international activities. These include new duties as President Elect of the International Astronomical Union; working as the Chair of the International Square Kilometre Array Steering Committee (ISSC); and participating in the OECD Global Science Forum Working Group on Radio Frequency Interference. While in North America, Prof Ekers will promote ATNF activities and plans for the Square Kilometre Array. He will also spend some time developing interactions between CSIRO and companies in the region.

Until Prof Ekers returns next April, Prof Ray Norris, Deputy Director of the ATNF is Acting Director, Mr John Brooks continues as Assistant Director and Dr Dick Manchester is the Acting Chair of the Australia Telescope Time Assignment Committee.

Steven Tingay
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Science meets Parliament

Every year the Federation of Australian Scientific and Technological Societies (FASTS) holds "Science meets Parliament". This event provides an opportunity for scientists to meet parliamentarians and their advisers, to inform them of the latest scientific developments and help strengthen the links between science and government. This year the event coincided with the announcement of the MNRF-2 funding, providing a great opportunity to talk to parliamentarians about astronomy. Over 100 scientists, including three from the ATNF, and two thirds of parliamentarians participated in the event, held in Canberra on 21 – 22 August.

The first day was set aside for a comprehensive briefing on the state of Australian science and the various techniques and appropriate etiquette for approaching, communicating with, and lobbying members of Parliament. This included question and answer sessions with a panel of parliamentarians and another panel of lobbyists and advisers, both of which provided valuable insights into the workings of Parliament.

FASTS arranged appointments for scientists to meet directly with parliamentarians on the second day. They endeavored to link scientists with politicians from their electorate and by topics of interest nominated by the Members and the scientists.

The majority of scientists were pleasantly surprised at the level of interest expressed by the politicians. Some Parliamentarians expressed the desire to have more frequent contact to discuss and explain the science issues of the day.

Those of us who attended found the event to be a positive and worthwhile exercise and would recommend it to all at the ATNF.

Further information on FASTS and Science meets Parliament is available at *http://www.fasts.org*.

Jim Lovell (Jim.Lovell@csiro.au)
Aaron Chippendale, Baerbel Koribalski

Active Galactic Nuclei variability workshop

In the last week of June, the ATNF headquarters in Marsfield hosted a prestigious, Elizabeth & Frederick White, international workshop on the "Variability of Active Galactic Nuclei across the Electro-Magnetic Spectrum". The meeting was sponsored by the Australian Academy of Science, the Anglo-Australian Observatory, the Research School of Astronomy and Astrophysics at the Australian National University, and the Australia Telescope National Facility. More than sixty participants from 14 countries attended the meeting and the majority presented talks and posters. Thanks to the strong Australian sponsorship, the list of invited presentations reflected a large variety of issues researched within this topic.

It is recognised that variability of Active Galactic Nuclei (AGN) is one of the most important tools for studying their detailed structure and emission mechanisms. AGN exhibit variability across the entire electromagnetic spectrum, on time-scales ranging from minutes to years.

Long term variability in AGN at radio frequencies has been recognised for almost 40 years and has been interpreted as due to intrinsic outbursts in the source, mostly related to shocks in jets extending from these objects. Relatively recent results from high energy instruments (HEGRA and EGRET in gamma-ray, ROSAT and XTE in X-ray) reveal strong outbursts in a particular class of AGN – blazars.

New developments in instrumentation, including improved sensitivity and stability, have enabled better temporal sampling and accuracy of flux density measurements. This has resulted in the discovery of extremely short time-scale variability over the entire electromagnetic spectrum. Such variability, if intrinsic to the source, suggests extremely small sizes for the emitting source components. This often leads to unacceptable physical conditions such as excessive brightness temperatures and opacity problems.

The workshop participants

The interpretation of the short-term fluctuations at radio frequencies is still under debate. The evidence thus far suggests extrinsic mechanisms, such as interstellar scintillation, are dominant.

The intention of the workshop was to focus on the multi-wavelength variability of AGN, in order to improve our understanding of the mechanisms and the sequence of events that lead to the variability in different parts of the electromagnetic spectrum. To achieve this purpose, time for an extensive discussion of the latest observational results and theoretical interpretations was allocated in the workshop program.

Participants discussed monitoring strategies necessary to acquire simultaneous observations of the flux density variations over the entire electromagnetic spectrum. Such monitoring was recognised as a crucial step for a full understanding of activity in the innermost regions of AGN. A proposal to form an International Astronomical Union Commission dedicated to multi-wavelength studies of AGN was an outcome of this discussion.

The international astronomical community was made aware of the strength and activity in observational and theoretical studies of the AGN intraday variability in Australia. In particular the workshop conveyed strongly the importance and implications of the extrinsic interpretation of intraday variability at radio frequencies.

Participants of the workshop were offered a number of accompanying activities by the Local Organizing Committee. One such event was a special presentation by the master of astronomical photography, Dr. David Malin, titled “A Universe of Colour”. A display of the Luneberg Lens prototype with Peter Hall’s commentary was received with interest. Similarly, the evening screening of the recently released movie “The Dish” brought a sizable audience.

The relaxing atmosphere of the Harbour Cruise Workshop Dinner was enhanced by an opportunity for star-gazing, an unique experience for people who came to Australia from the northern hemisphere.

The scientific benefit of this meeting is already visible in the large number of submitted conference proceeding papers, which are due to be published in Australia’s own astronomical journal, the Publications of the Astronomical Society of Australia (PASA), in the January 2002 issue.

The organisers of the Workshop, Lucyna Kedziora-Chudczer and David Jauncey, would like to offer warm thanks to the workshop sponsors for their generous financial support, and also to all the ATNF staff (especially Sue Little, Anne Barends and Phil Sharp) who helped to make this meeting a very enjoyable and memorable experience.

Lucyna Kedziora-Chudczer
(Lucyna.Kedziora-Chudczer@csiro.au)

ATNF-led BHAG proposal submitted

In response to the call from CSIRO’s Chief Executive, Dr Geoff Garrett, for Big Hairy Audacious Goals (BHAGs) to carry CSIRO forward over the coming years, the ATNF, in partnership with a number of other CSIRO Divisions, has submitted a BHAG proposal titled “Catalysing the Australian Space Industry”. Prof. Ray Norris, Deputy Director of the ATNF, is the process owner for this proposal and Dr Steven Tingay is the proposal coordinator. The overall aim of the proposal is to lever the many groups within CSIRO that engage in space-related research into a force for change within the Australian space industry. This will complement recent support from the Federal Government for the launch facility infrastructure development currently underway on Christmas Island and other government initiatives.

The Space BHAG proposal is a partnership between 11 CSIRO Divisions and is one of 15 such proposals before the CSIRO Executive. The proposal was submitted on 15 October and some results from the selection process are expected in early November.

Steven Tingay
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Narrabri Synthesis Imaging Workshop

Prof John Storey in discussion with workshop participants

The 5th ATNF Synthesis Imaging Workshop was very successfully held at Narrabri during the week of 24 – 28 September. The number of attendees was larger than expected, and included 35 post-graduate students, 10 post-docs and a few undergraduates. There were about 30 speakers and other helpers in addition to this. In comparison to previous workshops, the group included a larger fraction of students who were predominantly interested in wavelengths other than radio.

This year we included two "practical sessions" and a site tour to complement the formal lectures and tutorials. During the practical sessions, the students were able to take part in activities which included observing, data analysis, working with a basic interferometer operating at 20 MHz, and using the ATCA antennas as single dishes at both millimetre and centimetre wavelengths. All the formal parts of the workshop were well rated by the students, with the practical sessions, in particular, being highly successful.

The workshop presentations and some tutorial and practical session material are now available on the web at *http://www.atnf.csiro.au/synthesis/talks.html*.

The Narrabri staff out-did themselves in the local organisation and, unlike the workshop in 1998 (floods!), the weather was excellent. The students, in particular, enjoyed the workshop reception (camp oven meal and campfire) on the Monday, and an after dinner talk by Prof John Storey on "Radio Astrology'" on the Wednesday evening. Thanks are due to all the speakers and Narrabri staff for making this workshop very successful and enjoyable.

Bob Sault
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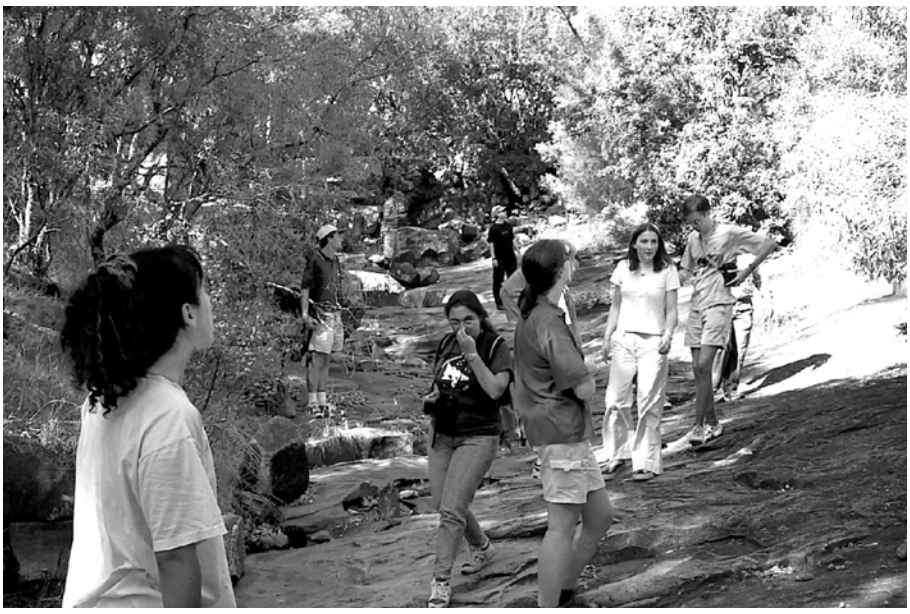
Editors note: And thanks especially to Bob for an excellent workshop.



Bushwalking at Sawn Rocks on Friday afternoon

Two new post-doctoral appointments at ATNF

During September, we welcomed two new post-docs to the ATNF. They are Naomi McClure-Griffiths, the 2001 Bolton Fellow, and Daniel (DJ) Pisano, who was awarded a US National Science Foundation Mathematical and Physical Sciences Distinguished International Postdoctoral Research Fellowship to work at the ATNF for two years.

Most of us know Naomi well, as she has been a frequent visitor to the ATNF, working at Narrabri and Parkes on projects related to the HI Southern Galactic Plane Survey (SGPS). She grew up in Portland, Oregon and did her undergraduate degree in physics at Oberlin College, Ohio. While there she did an honours project with Dan Stinebring and she made her first visit to the ATNF in late 1996, spending four months working with Dan and Simon Johnston on diffractive scintillation of PSR B1259-63. Following graduation from Oberlin in 1997, she commenced a PhD with John Dickey at the University of Minnesota, working on the SGPS. This survey resulted in very detailed images of the neutral hydrogen in the disk of our Galaxy and has given new insight into large-scale emission structures such as HI shells, supershells, and chimneys.

Dr Daniel (DJ) Pisano and Dr Naomi McClure-Griffiths

As a Bolton Fellow, Naomi has a three-year appointment with the ATNF. She has chosen to be based at Marsfield, but as a keen observer, she will often be seen at the Observatories. She plans to continue and extend her work on the HI distribution in the Galaxy, with the aim of understanding the physical processes involved in large shell and chimney formation as part of the disk-halo interaction. There are also plans to extend the SGPS through the Galactic Centre.

Daniel J (DJ) Pisano graduated with a BS in Astronomy & Physics from Yale University in 1996 and completed his PhD in July at the University of Wisconsin - Madison under the supervision of Eric Wilcots. DJ's main interests are in understanding how galaxies assemble their mass and how minor accretion events help drive the evolution of galaxies. His thesis involved surveying a sample of isolated galaxies in HI using the VLA and ATCA in a search for the gaseous remnants of the galaxy formation process. DJ has also done HI and optical studies of the dynamics and star formation properties of NGC 925, and carried out Arecibo observations of nearby blue, compact galaxies to determine their gaseous properties.

As mentioned above, DJ was awarded a National Science Foundation Fellowship to work at the ATNF for two years. As with Naomi, he will be based at Marsfield, and also concentrating on HI studies. However, DJ's interests are more in relation to external galaxies and loose groups of galaxies. In particular, DJ plans to use the Parkes Multibeam receiver to search for low-mass HI clouds in groups of galaxies similar to the Local Group. DJ is also studying the HI properties of nearby luminous blue compact galaxies to better understand the fundamental nature of this class of galaxies and how they might evolve.

Dick Manchester
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regular items

ATNF Astrofests

The latest ATNF astrofest was held on 6 June in Marsfield. There were interesting new results on the CO-HI relationship in galaxies, monitoring of the expansion on the sub-parsec-scale in Centaurus A, new gravitational lenses, new pulsars, and new images of the Vela SNR (see the full program at *http://www.atnf.csiro.au/research/astro/astrofest-06-June-2001.html*).

A most interesting contribution was a duet by Ron Ekers and Dick Hunstead describing observations of a fascinating steep spectrum source discovered by Haida Liang, the origin and distance of which provoked much discussion. Talks on aips++ and ALMA also proved interesting.

In a break from the usual canteen or barbecue lunch, the astrophysics group had lunch at a nearby restaurant, which made for a very jovial astro business meeting in the afternoon, the minutes of which can be viewed at *http://www.atnf.csiro.au/overview/management/meetings/astro_2001jun.htm*.

The next astrofest is scheduled for 5 December. All welcome. See *http://www.atnf.csiro.au/research/astro/astrofest-05-Dec-2001.html*.

Lister Staveley-Smith
Head of Astrophysics
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ATNF graduate student program

It is a pleasure to welcome Catherine Drake (RSAA, ANU), who has recently joined the ATNF/Universities co-supervision program as a PhD student. Catherine's project is "Intermediate Radio-Loud IRAS Galaxies" and her supervisors are Peter McGregor (RSAA,ANU), Michael Dopita (RSAA, ANU) and Ray Norris (ATNF).

It is also a pleasure to congratulate Nina Wang from Urumqi Astronomical Observatory who recently obtained her doctorate on "Pulsar Timing and Scintillation Studies" from Peking University.

Lister Staveley-Smith
Graduate Student Coordinator

ATNF work experience students

In September and October, the Narrabri Observatory hosted three work experience students. Ms Tamsin Gray joined us from Britain in late September, escaping the chilly north for a month of sun and astronomy in Australia. In addition, two students came to us through the CSIRO Student Research Scheme (SRS) in mid-October for a two-day visit, Ms Sussan Deng and Ms Kamila Marzec, both from Sydney Girls School. The CSIRO SRS operates through most CSIRO Divisions and is designed to give upper high school students a taste of the day-to-day activities of scientists. More information on the CSIRO SRS can be obtained from *education@helix.csiro.au.*

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1000 projects at the Australia Telescope Compact Array

On 2 September 1988, the Australia Telescope Compact Array was officially opened by the Prime Minister, Hon. R.J.L. Hawke, as part of Australia's bicentennial celebrations. The first radio astronomy observations followed soon afterwards with a single-baseline interferometer operating in December 1988. A major milestone was reached in June 1989 with the first Compact Array image, obtained using three antennas, showing 6-cm emission from the radio galaxy PKS 2152-699.

The inaugural meeting of the ATNF Steering Committee was held in May 1989. At this meeting major policy decisions were made which have provided the ATNF with an efficient operational structure for over a decade. One of these was that "*the ATNF will particularly welcome overseas scientists wishing to spend some time at the Facility"*. The many visits to the ATNF from overseas colleagues and the collaborations between Australian and overseas astronomers have contributed greatly to the success of the ATNF.

The Australia Telescope became a National Facility on 2 April 1990. Since then observing time has been scheduled for 1000 different projects. Together these represent approximately 1000 astronomers from 40 different countries. Project C1000, led by Carlos de Breuck from the Institut d'Astrophysique, Paris, is a collaboration between French, Australian and US astronomers. The observing time, scheduled for December 2001, will be used to investigate the radio continuum emission from high-redshift galaxies in the Sydney University Molonglo Sky Survey catalogue.

Jessica Chapman
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Symposia and workshops – November 2001 to February 2002

The next Australia Telescope Users Committee (ATUC) meeting will be held on 13 – 14 November 2001, at ATNF headquarters, Marsfield. All users and interested parties are welcome to attend the ATUC open session on 13 November.

IAU Symposium No. 209, "Planetary Nebulae: Their Evolution and Role in the Universe", will be held in Canberra at the Mount Stromlo Observatory of the Australian National University, 19 – 23 November 2001. Information may be found at *http://www.mso.anu.edu.au/~pn_symp/*.

A workshop on "Millimetre Science with the upgraded Australia Telescope" will be held at the University of Melbourne on 29 – 30 November 2001. Information may be found at *http://astro.ph.unimelb.edu.au/events/conferences.html*.

A workshop on "Next-Generation Astronomical Surveys: Opportunities and Science Drivers" will be held at the University of Sydney on 3 – 4 December 2001. Information may be found at *http://www.physics.usyd.edu.au/astrop/NGAS_meeting/*.

The next ATNF Astrofest will be held on 5 December 5 2001, at ATNF headquarters, Marsfield.

Mount Stromlo Observatory will host the Charlene Heisler Workshop 2001 (Sixth Annual Stromlo AGN Workshop), 6 – 7 December 2001. Information may be found at *http://www.mso.anu.edu.au/~dekool/agn2001.html*.

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news

An update on siting of international distributed radio telescopes

Planned facilities

There are currently two significant distributed radio telescopes being planned which require extensive protected areas:

1. LOFAR - the Low Frequency Array, operating at low frequencies between 10 – 220 MHz. This is an initiative of the Netherlands Foundation for Research in Astronomy (NFRA) and several organisations in the USA including the Naval Research Laboratories. The final date for siting proposals is September 2002;

2. Square Kilometre Array - the frequency range of coverage is assumed to be approximately 150 – 1500 MHz for Mid-SKA, and 1 – 23 GHz for High-SKA, with a proposal for siting required by 2005.

Both LOFAR and SKA will require protection for the closely spaced antennas on the central site. The maximum extent of LOFAR is 350 km while the SKA will extend to continental distances (in its final form). Australia has a number of suitable areas, which could accommodate the SKA and also LOFAR (if requested by the LOFAR consortium).

The SKA - international activities

The International SKA Steering Committee has appointed a Site Evaluation and Selection Committee with a representative from each country, or region, potentially interested in hosting the SKA. These are:

· northern hemisphere – Europe, China, India, USA;
· southern hemisphere – Australia, South Africa.

Australian siting issues

In addition to the interest of Western Australia in providing a site for LOFAR and SKA, South Australia is currently preparing a case for funding to carry out site investigations for the SKA. This will include a radio-quietness testing program. A possible site near Lake Frome, northwest of Broken Hill, may be investigated first. Broken Hill is also interested in the possibility of being a "base" for engineering services, and a site in New South Wales between Tibooburra and White Cliffs may be investigated.

Progress in Western Australia

Two adjacent areas in the Murchison between Geraldton and Meekatharra have provisionally been set aside by the Western Australian Government as possible sites. Investigations are proceeding for an area east of Kalgoorlie, north of the Transcontinental Railway.

The Western Australian Government has also appointed a contractor to undertake an intensive three-week high-sensitivity measurement program to determine the amount of "used" spectrum. The program was undertaken on Mileura Station, 100 km west of Meekatharra, during March-April this year. Not all the data has yet been analysed, but the services which are in evidence over the 30 – 1810 MHz frequency range include satellite downlinks, TV and FM broadcasts, Telstra phone/fax/email services to homesteads, and aircraft communications (short-period).

The proportion of "unused" spectrum, to the sensitivity limits of the measuring system, is given below and is seen to be very high. (The data for the band 350 – 1060 MHz have not yet not been fully analysed).

Further tests for the second area in the Murchison are planned, possibly in March 2002. This program will include sample testing the spectrum that appears to be unused, with an equipment configuration having higher sensitivity.

Acknowledgement
The assistance of Aaron Chippendale in analysing the data provided by the contractor is gratefully acknowledged.

Bruce MacA Thomas
SKA Site Engineer
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Frequency Range (MHz)	*Total Bandwidth (MHz)*	*"Unused" spectrum*	
		Bandwidth (MHz)	*Band-vacancy (percent)*
30 - 150	120	105*	> 98%
	* night-time operation		
150 - 350	200	130	> 96%
1060 - 1800	740	700	> 99%

Radio-quietness: summary of results

Notes from the Australia Telescope Compact Array millimetre upgrade

Work has been continuing on the MNRF upgrade since our initial 3-mm single-baseline observations last November (see ATNF News No. 43, February 2001). In June/July, we installed improved versions of the 3-mm and 12-mm indium phosphide receivers in antennas 3 and 4 with dual-polarisation capability. At the end of September, the 3-mm receivers on antenna 2 became fully functional, and the new 3-element system appears to be performing well. A high-frequency (13.6-GHz) local oscillator (LO) signal is now distributed to the antennas via optical fibre, and an absorber mounted on a paddle can be swung in front of each 3-mm horn by computer control in order to measure the system temperature. Cyclic pointing errors have been eliminated by adjusting the encoder electronics. The current status of the MNRF upgrade can be found at *http://www.atnf.csiro.au/mnrf/3mm_details.html.*

The 3-mm science team, led by Baerbel Koribalski, has been generously allocated time for test observations, following the June and September shutdowns. Spectra of several interesting sources were obtained with the single-baseline system in July. Also during that time, we successfully implemented a "fast-switching" technique for phase calibration using the Compact Array's mosaicing mode, and made estimates of antenna sensitivity by observing Uranus across the entire 3-mm band (planets are among the only sources with well-known millimetre fluxes). More recently in September, we've observed several sources with the three-element system in the 750D configuration (baselines of 180 – 580 m) and are planning additional observations in the new ultra-compact EW352 configuration (baselines of 45 –
120 m) in October, which will hopefully provide sufficient (u,v) coverage to generate our first astronomical images.

Shown here are two of the spectra taken in July: (1) SiS (5-4) emission from the envelope of the evolved star IRC+10216; and (2) HCO+ (1-0) emission from the N113 molecular cloud of the LMC. The third plot shows the closure phase vs. time for a nine-minute observation on the bright quasar PKS B1921-293, taken with the three-element system on 28 September. While phase variations on individual baselines were as large as 360 degrees, the closure phase is consistently close to zero, as expected.

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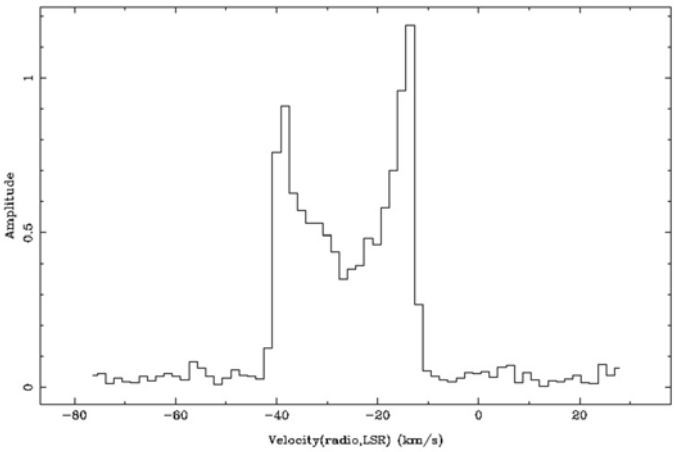
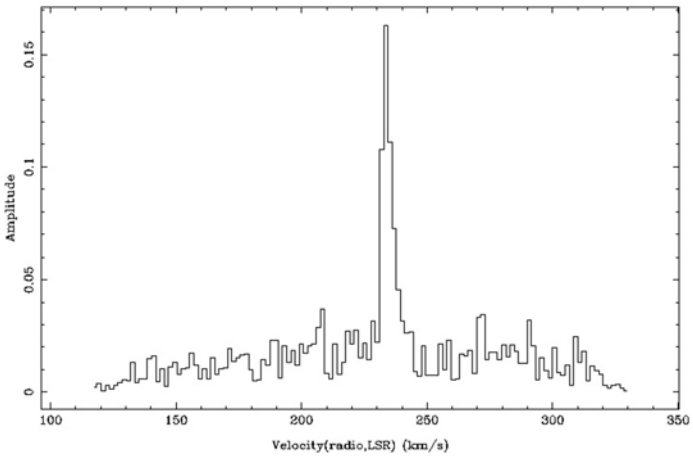
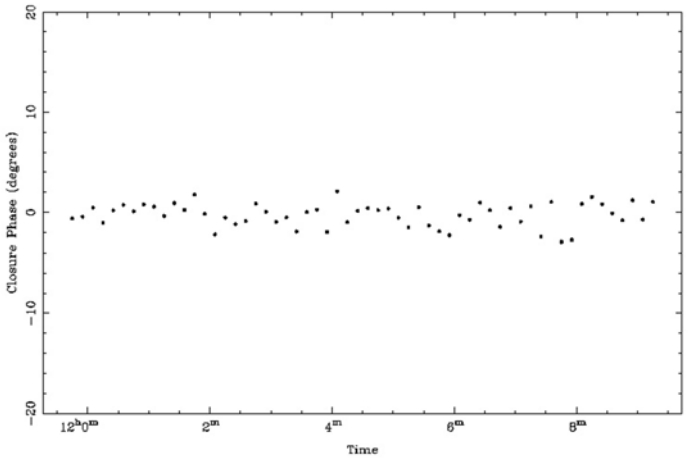


SiS (5 – 4) emission from IRC+10216



HCO⁺ (1 – 0) emission from N113



3-mm closure phases for PKS B1921-293

Articles

Focus on the history of Australian radio astronomy

Introduction

Ever since their pioneering efforts in radar technology during WWII, Australians have been at the forefront of international radio astronomy (Sullivan 1988). The earliest observations of importance were conducted by staff from the CSIRO's Division of Radiophysics at the Dover Heights field station in Sydney (see papers in Goddard and Haynes 1994), which was soon joined by other major field stations at Potts Hill, Dapto and Fleurs. During the 1950s and 60s other smaller and often temporary field stations were established at such scattered places as Badgery's Creek, Georges Heights, Hornsby Valley, Murraybank and Penrith.

Christiansen (1984: 113-115) has painted a poignant picture of these field stations:

"The field work had a pioneering appearance. Each morning people set off in open trucks to the field stations where their equipment, mainly salvaged and modified from radar installations, had been installed in ex-army and navy huts. At the field stations the atmosphere was completely informal and egalitarian, with dirty work shared by all.... there was no place for observers who were incapable of repairing and maintaining the equipment."

This idyllic existence came to an abrupt end with the construction of the Parkes Radio Telescope. The 64-m antenna marked the start of an era of 'big science' in Australian radio astronomy (Robertson 1992), and heralded the closure of the scattered field stations.

Historians of science are very fortunate that for much of its existence the Radiophysics/ATNF infrastructure allowed the employment of professional photographers, and through the efforts of the late Ken Nash, John Masterson and their assistants an up-to-date visual record of personnel, special events, new radio telescopes and auxiliary equipment was maintained. This unique heritage resource is currently under the stewardship of the ATNF in Sydney.

The ATNF historic photographic archive

The Historic Photographic Archive dates from 1939 and comprises ~50,000 individual negatives or slides, and associated prints. The negatives are in envelopes and stored in metal card cabinets, while the slides are in two filing cabinets and two large purpose-built "slide cabinets" with horizontal shelves and built-in light boxes. The prints, for the most part, are housed in filing cabinets and in numbered "photo books".

Documentation on the images is preserved in a Filemaker Pro database, and a start has been made transferring the most interesting and historically-significant images onto a digital image-library database.

Recently, the collection was relocated to a new purpose-built room at the ATNF's headquarters, and temperature and relative humidity are maintained at acceptance levels with the aid of a dedicated air conditioning unit and a dehumidifier.

Even a cursory survey of the negative cabinets and print files reveals a veritable treasure-trove of riches. In addition to images of many the key figures in Australian radio astronomy, there are photographic records of key events in the history of Australian radio astronomy – such as the official openings of the Parkes Radio Telescope, the Culgoora Radioheliograph and the Australia Telescope (Figures on pages 14 and 15).

The collection also contains panoramic views of many of the Division's field stations, and photographs of most of the radio telescopes made at one time or another by or for Radiophysics and later the ATNF.

For example, from Dover Heights we have the 2, 4, 9 and 12-Yagi arrays, the 4.9-m parabola atop the WWII blockhouse and the famous 21.9-m 'hole-in-the-ground' antenna that was later extended to 24.4 m (Figure 2). Australia's mini-Aricebo was used to survey the sky at 160 MHz and to search for the deuterium line (Bolton 1982).

Dapto is well-represented by views of the field station and those distinctive rhombic aerials (Figure 3) used for spectrographic solar studies, and to this group we should perhaps add the original prototype antenna which was located at Penrith.

The Potts Hill field station contributes a *pot-pourri* of instruments: Yagi arrays and stand-alone parabolic antennas used for solar work, the grating interferometer situated beside one of the reservoirs, the rectangular parabolic antenna and the 11-m dish used for the early H-line work, and the prototype 'Mills Cross' (Figure 4).

The collection also contain photographs of the broadside arrays used for the 3-element interferometer which were situated at the short-lived Badgery's Creek site, and of the 6.5-m dish that was erected at the Murraybank field station for dedicated H-line work.

For its part, Fleurs boasts a series of excellent aerial views of the site, plus details of the Chris Cross, Mills Cross and Shain Cross (see Figure 5). Also represented is the 18.3-m antenna, used in conjunction with the E-W arm of the Chris Cross before its transfer to Parkes, and some of the temporary antennas used by Slee *et al.* for long baseline interferometry. There are also images of the barley sugar arrays used at some of the remote sites, including the one at Llandilo that I clearly remember visiting with Sheuer back in the 1960s while serving as his technical assistant.

Understandably, the Parkes segment of the collection contains a large number of colour and black and white images documenting the design, construction and research programs associated with the 64-m antenna, and its 18.3-m satellite parabola (eg see Figure 6).

Culgoora boasts a 35-year record of achievement, beginning with the site preparation and construction of the Radioheliograph and extending to the establishment and subsequent development of the Australia Telescope Compact Array. Forming a natural extension of this latter sequence are images of the Mopra dish near Coonabarabran.

Finally, the Division's current Marsfield site is represented as the home of the 4-m precision-built radio telescope that was opened in 1976 and used for molecular line studies of the Galaxy at millimeter wavelengths.

Although some of the images in the collection have already appeared in print (e.g. see Deane 1985; Sullivan 1984), the ATNF Historic Photographic Archive remains an invaluable resource for those researching the history of Australian astronomy or international radio astronomy. The Archive also has enormous educational potential – particularly at the secondary school level – and given the heightened public interest in both astronomy and Australian history it could also serve as the basis of a succession of popular travelling exhibitions. These are but some of the ways in which this important collection can be used to promote science and technology and allow the Australian public to share in the achievements of some of our most famous scientific sons and daughters.

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Figure 1: Top centre - The opening of the Australia Telescope on 2 September 1988.
Figure 2: Bottom left - The Dover Heights 'hole-in-the-ground' antenna.
Figure 3: Top left - The rhombic aerials at Dapto.
Figure 4: Bottom right - A view of Potts Hill showing the prototype Mills Cross and in the background two of the antennas used for H-line work.
Figure 5: Bottom centre - A view at Fleurs showing the central section of the Mills Cross and in the background part of the Chris Cross..
Figure 6: Top right - The 64-m and 18.3-m radio telescopes at Parkes.

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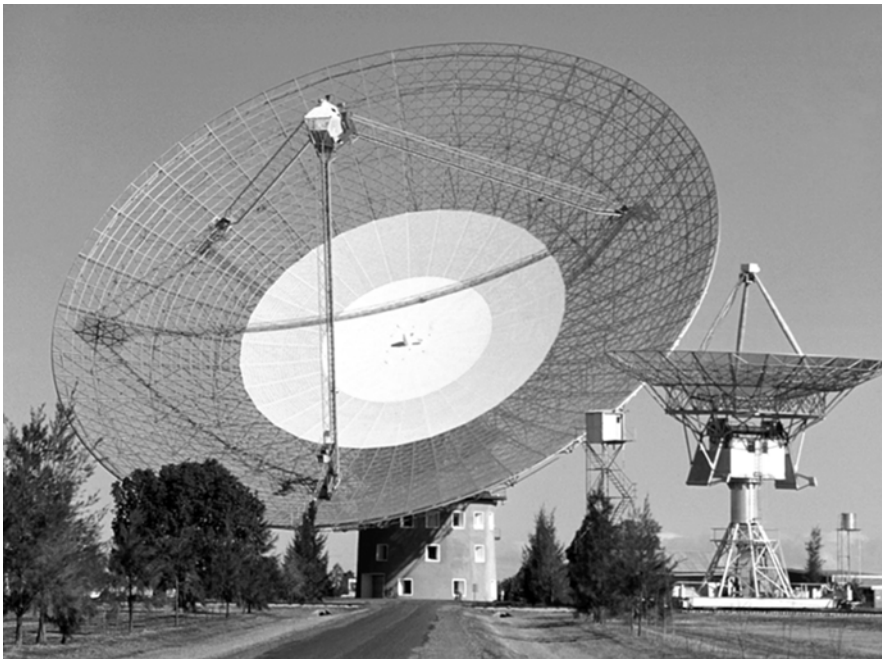

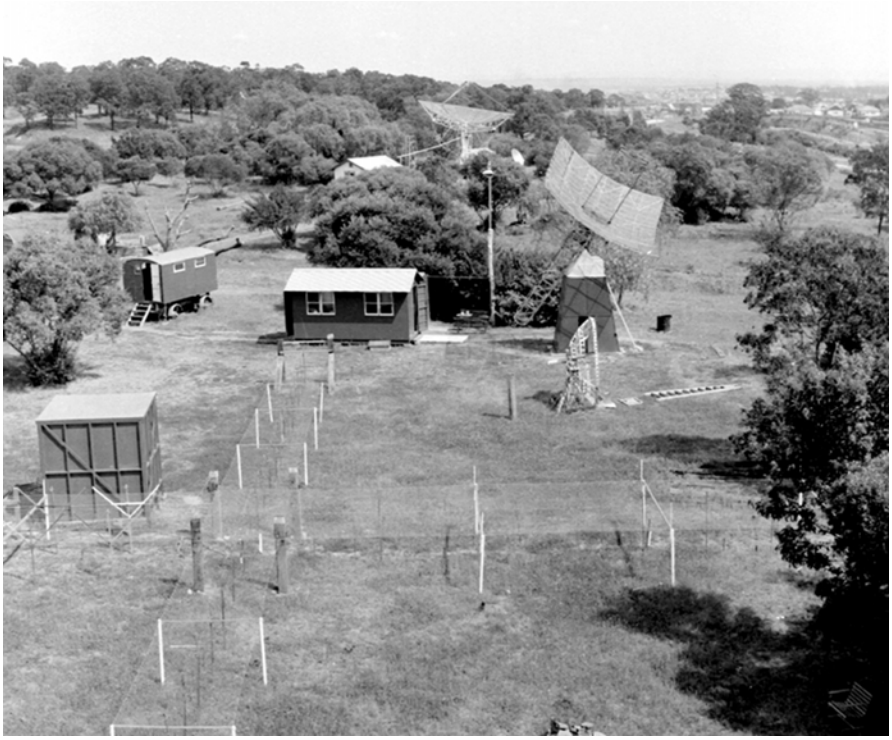

articles

Millimetre-wave solar radio astronomy in the CSIRO Division of Radiophysics, 1973 – 1977

I read with interest the letter from Stephen White in the June 2001 edition of the ATNF Newsletter, pointing out that the current 3-mm upgrade of the ATCA, while providing powerful new facilities, will not provide the *first* 3-mm interferometer in the Southern Hemisphere. I would like to thank Stephen for his letter. This article aims to present a more extensive outline of the mm-wave solar radio astronomy instrumentation and research at Radiophysics during the 1970's – projects that also shaped my later career in mm-wave engineering.

The mm-wave radio telescopes for solar radio astronomy were designed and developed during my PhD research project, between 1973 and 1977 at Marsfield, under a collaboration between the Department of Electrical Engineering at Sydney University and the Division of Radiophysics. To the best of my knowledge, it was the first joint PhD project of this type, with Norman Labrum of CSIRO and Godfrey Lucas at Sydney University providing supervision. Staff from CSIRO who gave engineering and technical assistance included Chris Smith, Keith McAlister, Keith Anderson and Claude Scarpellino.

These projects aimed to determine the distribution of millimetre wavelength brightness over the quiet sun in order to test the validity of existing models of the solar chromosphere. Limb brightening had been predicted by these theoretical models, but earlier mm-wave observations had given widely varying and conflicting results. Two mm-wave telescopes were designed and constructed during this project.

The first, shown in the photographs in Figures 1 and 2, was a phase-coherent, two-element interferometer, using a pair of 30-cm-diameter, cassegrain-fed

Figure 1: The 100-GHz interferometer with the 4-m telescope in the background

paraboloids in a ceolostat configuration. It was designed to operate over a range of east-west oriented baselines with spacing varying from one to six metres and was located close to where the near-field antenna ranges are today at the Marsfield site. To the best of my knowledge, it was the world's first 100-GHz variable-baseline, two-element coherent interferometer for radio astronomy.

A novel dual-mode feed-horn coupled the signals from each dish to a double-conversion, double-sideband receiver. The signal was first fed to a waveguide-mounted gallium arsenide Schottky diode mixer, which was followed by a low-noise, high gain transistor amplifier operating over the 1150 – 1250-MHz band. The second IF amplifier was centered on 234.8 MHz. The overall double sideband noise temperature of the receiver was about 8000 K, with 85 dB gain before cross-correlation.

Klystron tubes were used to provide local oscillator (LO) signals for the mm-wave mixers. A complicated phase-servo system was developed to phase-lock the two klystrons to reference signals at a sub-harmonic (near 2.9 GHz) of the 98.8-GHz LO frequency. Stability in relative phase of these pilot tones was ensured by deriving them from a mixer, which combined two 482-MHz signals (offset slightly in frequency) transmitted in opposite directions along a cable linking the two LO systems. The relative phase was then nearly independent of the electrical length of the connecting cable and the klystrons were maintained in-phase to a precision of about 10 degrees rms under ambient temperature changes.

Delay compensation was implemented by manually inserting lengths of cable in the IF channels. The correlator consisted of a pair of doubly-balanced mixers connected to provide "sine" and "cosine" baseband outputs. The correlator outputs were digitised so that fringe-fitting and integration could be carried out using a very early model "Alpha" mini-computer.

Norm Labrum and I used the interferometer to synthesise an image of the sun at 3-mm wavelength. The angular resolution achieved was of the order of 1.6 arcminutes. In order to present a more complete picture of the millimetre-wave brightness distribution, additional information was obtained from observations of the solar disc during the total eclipse of 23 October 1976 from a location near Stawell in Victoria. Measurements of the millimetre-wave brightness were made using the second telescope, a 1-m diameter dish, which was set up to track positions on the solar disc at the four points of contact. One of the interferometer receivers was modified for use in the eclipse work. The antenna used for the eclipse observations is shown in Figure 3, along with a very much younger version of the author.

Figure 2: One of the interferometer antennas plus associated receiver electronics

The interferometer and eclipse results, taken together, indicated that the solar brightness distribution at a wavelength of 3-mm was constant over the disc except for a narrow bright ring at the solar limb. The degree of brightening was observed to be about 20% above the intensity of the central disc and its angular extent was about 20 arcseconds at the limb. The detail of the limb spike was determined primarily from the eclipse experiment, since the angular resolution achieved with the interferometer was insufficient to resolve this narrow feature. The synthesis result confirmed that the brightness temperature distribution is flat from centre to limb to within ± 5%, with the principal limit on the resolution being the effect of weak localised sources associated with solar active regions, which are almost always present.

This project was a very exciting and challenging part of my research experience - a time which I will never forget and which formed the foundation of my further career. Plans were well advanced in 1976 to construct a larger interferometer for solar work, based upon the smaller system, which combined the 4-m Krupp dish with a new 2-m diameter reflector, which was made in Australia. Unfortunately, when I left CSIRO to take up a position with NRAO in 1977, the interferometer work lost impetus because of funding and staff difficulties at that time. It was never taken very much further. However, you can still see the remnants of the 2-m dish mount out on Bowen Field at Marsfield and the 2-m diameter aluminium reflector still lies in a shelter down behind the workshop!

Figure 3: The author with the 1-m antenna used for 100-GHz eclipse observations

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Continued from page 1

Major National Research Facilities funding for Australian astronomy

proposals spanned a wide range of disciplines: biotechnology, information technology, medicine, agriculture, mining, manufacturing, and marine research. A total of 86 proposals were submitted to the Program and 37 were short-listed before selection of the final 15, which also cover geographical locations in all Australian states and territories.

Senator The Hon Nick Minchin, Minister for Industry, Science and Resources, announcing the successful proposals.

The combination of optical and radio astronomy priorities in the proposal mean that the activities of the Australian astronomical community as a whole are probably more closely aligned now than at any time in the past. The proposal also builds upon the strength and experience of the original MNRF-funded upgrade of the ATNF and University of Tasmania radio astronomy facilities - the high frequency upgrade of the ATCA and the upgrade of Australian VLBI facilities. These upgrades will be practically complete by the end of calendar year 2002.

Elsewhere in this issue, in Peter Hall's regular SKA report, a more detailed outline of the proposed SKA component of the new MNRF work is given.

Institutes that contributed to the successful proposal were: CSIRO ATNF; the Anglo-Australian Observatory; the Australian National University Research School of Astronomy and Astrophysics; Swinburne University of Technology; the University of Sydney; the University of Melbourne; and the University of New South Wales.

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Gemini south at sunset (photo courtesy of Gemini Observatory).

Regular items

Square Kilometre Array program report

The big news since the last SKA report is the successful Gemini/SKA MNRF bid (see the lead article in this issue). While final divisions have yet to be decided, at least $18M will be spent on Australian SKA research over the next five years. The main SKA threads of the MNRF submission were the construction of two SKA demonstrators, the development of important enabling technologies for the SKA, and the establishment of a supercomputer facility to support astronomy and engineering simulations needed in designing the SKA. The ATNF and the University of Sydney will undertake the SKA demonstrator work, while Swinburne University of Technology will lead the SKA simulation activities. Enabling technologies will be developed by the ATNF and CSIRO Telecommunications and Industrial Physics (CTIP), in collaboration with initial industry partners such as CEA Communications and Advanced Powder Technologies.

The exact form of the SKA demonstrators is still to be decided. However, full use will be made of existing telescopes and infrastructure at Molonglo and Narrabri. In the case of the ATCA, a prime deliverable will be a new wideband digital correlator which, as well as being of enormous scientific value to users of the recently upgraded instrument, will form the heart of the ATNF SKA demonstrator.

One suggestion for the ATCA demonstrator involves the provision of two additional SKA mini-stations placed on an extended north-south baseline. Each station may be equivalent in area to a ~15-m dish, but each would be based on multi-beaming antennas – such as Luneburg Lenses or phased arrays. Discussion over coming months will address the exact form of the demonstrator and it is likely that a final technology choice will be made by the end of 2002. (A discussion relating to the science with the ATCA demonstrator is scheduled for 6 November, at Marsfield).

While all existing SKA activities will continue, a number of new projects are planned. In particular, an integrated RF systems project and a phased array antenna project will be important constituents of the expanded CSIRO program. We also expect to have to manage many more industry and related research and development links as a number of potentially key SKA technologies can only be realistically developed in partnership with others. The Australian SKA Consortium (ASKAC), which has been active since early 2001, will be an important body in coordinating CSIRO and other Australian SKA work. ASKAC will also be represented formally on the Board of Management of the new MNRF.

The MNRF development has been exciting but work has also continued on a number of technical fronts in recent months. We have taken delivery of the 0.9-m Russian Luneburg Lens, described in the last ATNF News and, in conjunction with CTIP, have been assessing its performance using near- and far-field testing procedures. First results indicate good beamforming properties but precision tests to establish absolute gain and dielectric loss have proved quite challenging. However, the testing program is now close to completion. Having a real lens to assess has proved extremely useful and will, no doubt, be of lasting value in framing our design and analysis methodology for prototype Australian lenses. New links are currently being forged between various CSIRO and industry partners; these collaborations may deliver the artificial dielectrics that are central to the

manufacture of low loss, low cost, lenses.

As well as the lens antenna work, the ATNF is also expanding activities in the area of phased arrays. In collaboration with CTIP and ASTRON colleagues, we will shortly take delivery of a Dutch "egg-crate" Vivaldi horn array (similar to the THEA units). This will be used initially for experiments with the 0.9-m Luneburg Lens and as the antenna section of our first integrated RF assemblies.

Other major activities over the past few months include reduction of first Western Australia site test data; Bruce Thomas has provided a separate update elsewhere in this newsletter. Our Australian group was also very active and visible at the Berkeley SKA "Defining the Future" gathering. Full proceedings (including poster papers) are available on the Web at *http://www.skatelescope.org/skaberkeley/*.

On the local front, ASKAC met in Adelaide (South Australia) on October 4. The previous day was devoted to an SKA Science and Engineering Symposium; proceedings will shortly be available at *http://www.atnf.csiro.au/SKA/Aust_SKA_Symp_Home_Oct01.html.*

An increased industry presence was especially welcome at this gathering, as was South Australian political and government agency representation.

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Australia Telescope Compact Array report

Staff

After one year at the Observatory, Cliff Harvey has resigned to take other work in the Narrabri district. Cliff worked for most of his term in the Electronics Group as an assistant to Alan Day in the cryogenics area.

Although David Rayner was not formally a member of Observatory staff, we have seen so much of him over recent years that he feels like one of the family! He has now left us and his departure was marked by a riotous evening at Chan's Restaurant in Narrabri. David was a joint ATNF-University of Tasmania postgraduate student. His thesis work involved measuring circular polarisation with the Compact Array and he succeeded in reducing the measurement errors to levels unprecedented in radioastronomy. His work has rekindled theoretical interest in astrophysical circular polarisation. Since completing his PhD David has worked in several temporary roles with the ATNF, including a three-month sojourn in Narrabri, on various aspects of system performance related to operation at mm wavelengths. In particular his contributions to pointing calibration have been very valuable. His final contribution was lecturing at the Synthesis Imaging Workshop. Bob Sault gives a summary of the Synthesis Imaging Workshop elsewhere in this issue.

Operations

New Configuration

Part of the current ATCA upgrade provides new antenna stations to support improved compact antenna configurations, ultimately using the new North Spur to provide N-S baselines. The first new configuration to become available is the EW352 array, scheduled from 3 – 24 October 2001, with antennas on stations W102, W104, W109, W112, W125 (and antenna 6 on W392 as usual). This configuration, with its complimentary partner EW367, replaces the old 375-m array which was used for the last time on 12 July 2001. RIP 375-m.

MNRF Compact Array upgrade

Since the last edition of the ATNF News there have been two substantial interruptions to scheduled astronomy for further MNRF installation work. Substantial advances have been made in four important areas of the upgrade.

Local oscillator and signal distribution

In the final upgraded system the original "daisy-chained" coaxial cable based LO distribution to antennas will be replaced by dedicated optical fibres from the Control Building to each antenna station. Also, the digitised astronomical signals (the "IFs") will be transmitted from each antenna on single-mode rather than the original multi-mode fibres, and dedicated single-mode fibres will also provide time signal and ethernet services to each antenna station. In earlier editions of the ATNF News we have reported the laying of more than 40 km of optical fibre cables along the Array. Work has continued with the connecting (splicing) of these fibres at each end. Since the recent installation periods the 160-MHz LO reference is distributed to five of the six antennas on fibre, and a new high frequency reference (13-GHz) is distributed to the three antennas with new mm-wave receivers. Ethernet and time signals are now available on five antennas. The most recent progress is the transfer of data transmission to single-mode fibres in antennas 2 and 5. This allows the operation of those antennas on the new antenna stations W104 and W125.

Receivers

Three millimetre receiver packages are now installed on the Array in antennas 2, 3 and 4. Each operates at 12-mm (16089 – 18888 and 20089 – 22488 MHz) and 3-mm (84906 – 87305 and 88506 – 91305 MHz). Some 3-mm observations have already been made with three baselines. However a delay in provision of a module in the 12-mm conversion system for antenna 2 has postponed the availability of a three-baseline system at that band.

Water Vapour Radiometers

It is hoped that the upgraded Compact Array will be capable of correcting phase fluctuations of atmospheric origin through measurement of the water vapour column density for each antenna using a Water Vapour Radiometer. The radiometer design is a four-channel 22-GHz system which is distinct to the main astronomy receiver packages. Each radiometer uses a separate horn that is mounted close to the astronomy horn (the offset between radiometer and astronomy horns is approximately five arcminutes). Testing of two prototypes over recent months has provided some encouraging results:

- Temperature stability is excellent. Additionally, as designed, the multi-channel nature of the system gives it extra immunity to fluctutations caused by temperature changes in the components;

- The system temperature of the units is higher than expected. However their raw sensitivity is still quite adequate;

- Using simple calibration of the radiometer output, we can reduce the phase error to the equivalent of about 350μm of pathlength. The aim had been to correct to about 100μm. The dominant residual error is from 1/f noise originating in the RF amplifiers of the radiometer. Errors with timescales greater than about three to five minutes dominate the error power. We do not believe we can eliminate this by using better amplifiers or by cooling them; it would be possible by using fast astronomical switching. Alternatively, we may also be able to eliminate this by regularly switching in a simple load.

Antenna Control Computers

Three prototype Antenna Control Computers (ACCs) have been installed in antennas 2, 3 and 4 in parallel with the original PDP11/73 machines. The new units are connected via the new fibre based ethernet to the control computer network and are providing monitoring services for the new mm receiver packages.

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Parkes Observatory report

Staff

Lewis Ball has joined the Observatory on a six-month secondment from the University of Sydney and is doing a sterling job as deputy Officer-in-Charge, quickly immersing himself in all aspects of Observatory activity.

Dr Zheng-wen Sun and Dr Wei Xia Wang from the Urumqui Astronomical Observatory in China have arrived in Parkes for a one-year sojourn. Sun and Wang are receiver engineers building a new cooled L-band receiver for the Urumqui Observatory 25-M telescope, as part of a contract with the ATNF. Graham Gay of the Marsfield receiver group is also closely involved in this project and has spent several weeks at Parkes recently assisting Sun and Wang, and with local operations.

Stacey Jeffery has joined us as a trainee in adminstration and reception until the end of the year, and has quickly become an invaluable mamber of the Administration team.

Rob Eslick is back with us as a casual, assisting in site services including grounds maintenance. The long-overdue trimming of the trees in The Avenue is but one of Rob's visible contributions in recent months.

Kimberly Robertson has joined the dedicated and hardworking band of casuals working in Observatory Visitors Centre. With the sustained high level of visitor numbers in the 'post-Dish' era, we are relying enormously on this team to keep the VC running smoothly.

Operations News

Operations have proceeded very smoothly in the last few months, with few major technical problems of note. The fix to the SWEO drives made by Andrew Hunt (see ATNF News, June 2001 issue) has worked spectacularly well, with not a single problem with the antenna drives reported since. Other antenna systems have likewise performed reliably and the fraction of time to lost equipment remains at low levels - less than the time lost to wind and bad weather.

An operational problem that has affected observers and staff was the sudden collapse on 14th Sept of Ansett Airlines and its subsidiaries, including Hazelton. All regular air services to Parkes ceased on that date, and at the time of writing have only recently resumed on a limited basis, with an unpublished and uncertain timetable. Visitors who would normally use this service should contact Hazelton or the Observatory before booking travel.

The Galactic pulsar survey is approaching completion, as the list of new discoveries pushes well beyond 600. The high Galactic latitude surveys and globular cluster searches are also proving very productive. The Northern ZOA HI survey will be finished in December, completing the Northern HIPASS/ZOA extension to the original surveys. A Galactic bulge extension to the ZOA has already started and will run well into 2002.

Operational Developments

Mal Smith's Interference Monitoring System (IMS) is nearing completion, with full commissioning expected early in the new year. Parts of the system have already been put to good use, as was illustrated during a recent concerted campaign to identify an apparently new source of pulsed RFI impacting badly on the pulsar searches. It transpires that at the northerly observing angles now required to complete the survey, the DME ("Distance Measuring Equipment") beacon at Parkes airport is directly illuminating the feeds. The beacon contains modulation with strong components at 135 Hz and 675 Hz, which have been observed for some years but have only recently become particularly troublesome. Means of alleviating the problem are being actively pursued.

Stacy Mader has been adding some useful new features to the Parkes Website, including Web-based viewers for weather data, GPS timing and receiver usage. A Web-based sensitivity calculator is under construction. Steady progress continues with upgrading and revision of documentation and user manuals.

Site Services

A contract of approximately $AU100K has been let to manufacture replacement gearboxes for the zenith drive. The pinions in particular were inspected last May during a shutdown and found to be wearing noticeably. Given the overall state of wear of the gearboxes and the integral nature of the pinions and gearboxes, it has been decided to replace both gearboxes early in the new year. A substantial sum of money has been provided through CSIRO Corporate for this refurbishment.

The last few months have been no less busy than usual with, among other work, preparations for the Parkes Open Day weekend on 3 – 4 November in full swing. Lovers of the oleanders around the tower have been dismayed to find them removed and replaced by a selection of local native shrubs. The OiC takes full responsibility for this long overdue improvement! A number of other plantings and improvements about the site are also evident - thanks mainly to the efforts of Tom Lees and Rob Eslick. Keen-eyed observers will also note that the telescope tower has been resprayed with vermiculite, the final step in repairing the cracks and delamination that first appeared some years ago.

The two Observatory houses in the Parkes township and the third house about 1 km from the Observatory entrance have all been sold. The latter house, though in a handy position, was considered not worth refurbishing.The proceeds from the sale of the houses will be put towards a number of improvements and additions to the site buildings, particularly at the Quarters. Extensive repainting of the Quarters and Opera House (Administration building) has already been completed.

Visitors Centre

The Parkes Visitors Centre continues to attract large numbers of visitors, and fields enquiries from near and far. The usual surge in patronage over the school holiday period saw the record for visitor numbers broken yet again, with more than a thousand visitors per day.

Following the release of the video on October 10th, the complete set of Video, DVD and CD related to “The Dish” are now on sale. It is interesting that the fraction of visitors who admit to having seen the movie is steadily declining and is now below 50% —other forms of follow-on publicity are evidently taking over.

The 3-D audio visual show “Our Sun the Star” was a run-away success over the school holidays, outselling “The Invisible Universe” by a factor of twofor all categories except senior travellers who express a preference to learn more about the famous radio telescope.

The increase in visitors seems to be accompanied by what might be the leading edge of a few undesirable visitors: the large Earth globe was removed from its plinth in June, but fortunately was recovered from the car park as apparently it would not fit in the culprits car. The superficial damage was repaired and the globe has been reinstalled.

The fourth sandstone plinth in the revamped front garden is still unoccupied by a display. A competition for students to propose a display for the fourth plinth will be announced in an upcoming edition of CSIRO’s Double Helix magazine.

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Time Assignment information

Australia Telescope Compact Array millimetre upgrade

Good progress continues to be made towards the high-frequency upgrade of the Australia Telescope Compact Array. The full upgrade will add two new observing bands to the Compact Array: 12-mm (16 to 25 GHz) and 3-mm (85 to approximately 115 GHz). Three of the antennas are now equipped with millimetre receivers. These are operational in the 12-mm band, and in the 3-mm band over frequencies from 84.9 to 87.3 and 88.5 to 91.3 GHz. We expect that full scheduled millimetre observing will commence in 2003. Until then a limited amount of time will be made available for commissioning and test observations. Proposals for millimetre observations will be considered by the Time Assignment Committee. As the millimetre systems are being developed, we require that until further notice, all millimetre proposals include an ATNF staff collaborator. Up-to-date information on the system performance, and information on how to prepare for and undertake millimetre observations is available on the web at *http://www.atnf.csiro.au/people/twong/3mmguide/*.

Because of distortions to the wavefronts caused by variations in the earth's atmosphere, millimetre observations are best taken when the atmosphere is most stable. In general the best phase stability at the Compact Array occurs during the Australian winter months and during night times. It is strongly recommended that observers request observations during these times.

Long Baseline Array

The Australian Long Baseline Array consists of the Compact Array, the Parkes 64-m radio telescope and the Mopra 22-m telescope. This array can be used as part of an extended Australian network which includes the NASA antennas at Tidbinbilla and radio telescopes at Hobart, and Ceduna. The LBA is also used as part of the Asia-Pacific Telescope which links telescopes in Australia, Japan, China, Hawaii, South Africa and India, and for the VLBI Space Observatory Programme (VSOP).

We advise VLBI users that access to the Tidbinbilla 70-m antenna has been very restricted this year and this is likely to continue in 2002. Further information on access to the Tidbinbilla facilities can be obtained from John Reynolds (John.Reynolds@csiro.au).

The ATNF web pages for the Long Baseline Array are currently being updated by Roopesh Ojha. Two documents on "A Novice's Guide to using the LBA" and a "Note on Calibrators" have been added to *http://www.atnf.csiro.au/vlbi/* Comments and suggestions on the LBA web pages are welcome and can be sent to Roopesh.Ojha@csiro.au.

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ATNF publications list

Publication lists for papers which include ATNF data are available on the web at *: http://www.atnf.csiro.au/research/publications.*

Please email any corrections or additions to Christine van der Leeuw *(Christine.vanderleeuw@csiro.au).* This list includes published refereed articles and conference papers, including ATNF data, compiled since the June 2001 newsletter. Papers including one or more ATNF authors are indicated by an asterisk.

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