ATNF News

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FEATURES IN THIS ISSUE

CSIRO

Director's message

The appointment of a new Director inevitably heralds in a new era for an organization such as the ATNF. Over the past 15 years, the ATNF has built up a world-class reputation for scientific and technical excellence. Its success lies in its outstanding staff, the vision of its leadership – in particular that of the ATNF's foundation Director, Ron Ekers – and the strength of the community it serves. The ATNF now needs to build on this position, taking advantage of new opportunities including those presented by the next generation of radio astronomy facilities. In moving forward, the ATNF's primary aim must always be to serve its stakeholder base, providing the support necessary to strengthen the Australian academic community as a whole and to expand its links with university, government and industrial partners, both nationally and internationally.

In the short term, the main priority for the ATNF is the completion of the 3-mm system. The spectacular results obtained with the 12-mm system on SNR 1987A amply demonstrate the potential of the superb imaging capabilities of the Compact Array at millimetre wavelengths. The successful commissioning of the 8-GHz analogue correlator with the 12-mm receivers in October has also demonstrated the power of equipping the Compact Array with a wide-band system, underscoring the strategic importance of the wide-band upgrade of the Compact Array to be completed over the next few years as part of the MNRF-II program. Timely delivery of these systems is essential if the ATNF community is to exploit them fully. The ATNF is currently implementing new project management policies and procedures across its development program to facilitate this key outcome.

The strategic development work in the Square Kilometre Array (SKA) made possible by the MNRF-II program will continue to be another key aspect of the ATNF's activities over the coming years. The successful development of the Luneberg lens demonstrator and the comprehensive work done on site characterization has not only given Australia a lead role in the international SKA collaboration, but has also provided opportunities to engage in the Dutch/US LOFAR project. In that regard, the recent news that the Mileura site in Western Australia had been ranked first by the LOFAR site evaluation committee demonstrates the effectiveness of the strong partnership that the ATNF has built with government (WA) and industry (Connell Wagner) that led to the successful site submission.

Another highly successful partnership, between CSIRO and NASA, was recently celebrated by the dedication of the 8-GHz receiver by the US Ambassador at Parkes. This partnership stretches back over four decades and, with the opportunities provided by the next generation of Deep Space Networks, holds great promise for the future. The ATNF is also looking to develop new strategic partnerships in major new international initiatives such as International Virtual Observatory and the EU radionet programs.

It promises to be an exciting next few years for the ATNF. As Director, I look forward to helping ATNF capitalizing on these opportunities – maintaining and enhancing its reputation as a world-leader in the field of radio astronomy and technological innovation.

Brian Boyle
(Brian.Boyle@csiro.au)

Editorial

Welcome to the October 2003 issue of the ATNF newsletter.

It is with pleasure that we bring out this newsletter, our last issue for the year. As before, we are very happy at the response to our call for article contributions. Our sincere thanks to all contributors.

We have a variety of items in this newsletter. This is our first issue with the new ATNF Director, Professor Brian Boyle, and we begin with a Director's message. The 12-mm system continues to impress with its high performance as can be seen from the two articles on pages 14 and 17. With the recently held IAU General Assembly in Sydney behind us and with a heavy involvement of the ATNF staff at various stages and levels, we planned to bring together, for this issue, summaries of events related to and around the time of the IAU GA. Thank you to all those who responded. An interesting and informative account of the work involved in conducting a meeting of this size is given on page 6. Exciting developments happening within the ATNF Engineering Group are summarized on page 11. Important changes to ATNF time assignment processes are given in the report on page 29.

As always we welcome contributions for the forthcoming issues. Our next newsletter will be the February 2004 issue. We are always pleased to receive comments and suggestions for the newsletter. Please contact us at *newsletter@atnf.csiro.au*. A web version of the newsletter can be found at *www.atnf.csiro.au/news/newsletter*.

Lakshmi Saripalli, Jessica Chapman, Jo Houldsworth
ATNF News Production Team
(newsletter@atnf.csiro.au)

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News

A celebration at Dover Heights

Professors Ray Norris, Miller Goss, Marie Bashir, Dr Bruce Slee and Professor Ron Ekers at the Dover Heights reception on 20 July 2003.

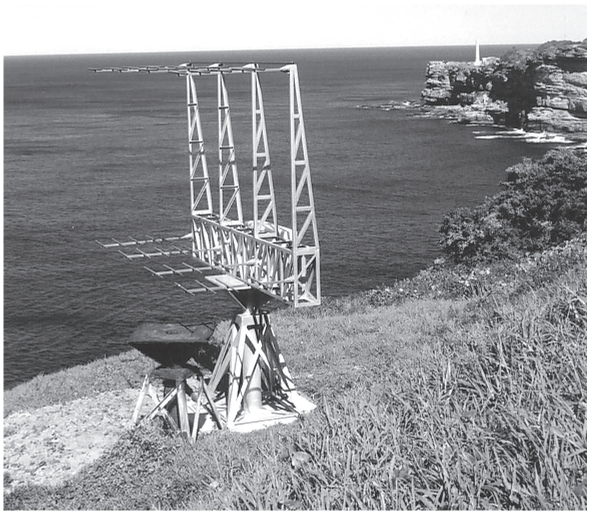
Rodney Reserve, on the cliff tops at Dover Heights in the eastern suburbs of Sydney was one of the most remarkable and important astronomical sites in New South Wales. Between 1946 and 1954, this former WWII radar station was the leading field station of the CSIRO Division of Radiophysics, and was home to a succession of different radio telescopes that were used to make outstanding advances in radio astronomy. Around 120 new radio sources were detected at Dover Heights. These were identified as gaseous nebulae in our own Galaxy, and as powerful sources of radio waves from distant galaxies. These discoveries showed that radio waves could be used to study the universe “from the solar system to the Cosmos” and firmly established Australia as a world leader in the emerging new science of radio astronomy.

To celebrate the history and achievements of the Dover Heights site, in November 2002, the ATNF submitted an application to the Waverley Council to build a scientific memorial on the site, consisting of a full-size replica of one of the early radio telescopes and a display panel with information about the site. After consultation with the local community and acquiring various environmental and heritage impact reports, this application was approved by the council in June 2003.

On 20 July 2003 a ceremony was held on Rodney Reserve to open the new memorial. The ceremony was timed to coincide with the historical sessions of the IAU General Assembly and many international and Australian visitors with a keen interest in the history of radio astronomy gathered for the event. Guest of honour at the ceremony was Her Excellency, Professor Marie Bashir, Governor of New South Wales. Professor Bashir gave an inspirational speech where she emphasized the importance of recognizing our scientific achievements and heroes. Other invited speakers were Professor Woody Sullivan (University of Washington, USA), Professor Ron Ekers (ATNF) and Mr Paul Pearce, Mayor of the Waverley Council.

On the day itself the weather was atrocious with dark grey skies, wind and driving rain. Fortunately, we had a marquee set up on the reserve and this was used for the speeches and reception. A brief lull in the rain allowed everyone to venture outside for a few minutes for the unveiling of the display panel. During the afternoon several astronomers recalled stories from their earlier days. Despite the weather it was a day to remember.

Jessica Chapman, Wayne Orchiston,
John Sarkissian
(Jessica.Chapman@csiro.au)



A full size replica of an 8-element Yagi array that was used at Dover Heights during 1951 – 1952. This was one of several Yagi arrays that were used on the site as a “sea interferometer”. In this technique, an interference pattern was recorded by combining radio waves detected directly from the source and from a reflection off the sea. The replica antenna has been installed on the cliff top next to the original mount, as a scientific memorial.

Australian SKA Consortium workshop on energy solutions for next generation radio telescopes

On Wednesday 10 September, ATNF hosted the "Energy Solutions for Next Generation Radio Telescopes" workshop, held in conjunction with the quarterly Australian SKA Consortium Committee meeting. The workshop gathered together power systems experts and other interested people to discuss ways of providing power at the Australian sites proposed for the next generation Square Kilometre Array (SKA) and Low Frequency Array (LOFAR) radio telescopes. Both SKA and LOFAR need to operate in radio-quiet areas, which, by definition, are remote areas with low population density. The challenge is to find ways to provide power for these telescopes in such remote areas. This is a key issue in the Australian bid to host these telescopes.

The meeting opened with a welcome from ATNF Business Development manager, Dr Carole Jackson, an outline of the scientific objectives of SKA and LOFAR from ATNF Director, Professor Brian Boyle and an overview of the engineering and energy requirements of these telescopes from International SKA Engineering Management Team chair, Dr Peter Hall. This was followed by a few suggestions for discussion on collaborative projects from ATNF SKA and LOFAR Strategic Support scientist, Dr George Warr.

CSIRO Energy Technology Renewable Energy Business Development manager, Dr Wes Stein, gave a review of fossil and renewable power generation methods. Covered were grid connected, coal, gas, diesel, hydro, biomass, wind, solar photovoltaic, solar thermal, geothermal and ocean wave power generation. Some of these, such as hydro, were not suitable to the proposed sites for the telescopes. Others, such as biomass, could potentially be used for co-generation to supply power to the core of the telescopes, where the energy requirements are highest, and provide power to the grid or other nearby facilities. It was noted, however, that it was more likely that dedicated systems would be used. For the more remote stations of the telescopes, solar, wind and battery with diesel backup systems were proposed. Wes concluded by noting that the telescopes had the opportunity to provide world-leading demonstrations of energy sustainability without compromising their primary radio-astronomy goals.

Several presentations were given by industry and university representatives. Presentations by Connell Wagner Pacific Power International Senior engineer, Tony Sproule, Norman, Disney and Young Director, Ashak Nathwani and GridComm Senior engineer Frank Mullins outlined their company's broad range of experience in power provision systems and power demand minimization strategies, such as the use of passive cooling systems and active climate control systems using the ground as a heat source and sink. UNSW Associate Professor Michael Ashley outlined their experience with remote power, control and monitoring systems in Antarctica and suggested ways that this may be applied to LOFAR and SKA. University of Sydney Principal Research Fellow and Solar Heat and Power chairman, Dr David Mills gave an overview of solar thermal power generation and its potential low-cost application to the telescopes. David noted that dramatic cost reductions could be made if thermal energy storage can be used and pointed out that solar energy is potentially one of Australia's most abundant energy sources.

The workshop finished with an open discussion session, led by Dr Carole Jackson. A wide range of issues were raised, such as the radio-quiet requirements of the power generation and distribution system, the potential use of hydrogen fuel cells for energy storage, the possibility of using super capacitors to meet peak power demands when rapidly slewing antennas, maintenance and upgradeability issues and the need for environmental monitoring and system modelling to design the power supplies.

Since the meeting, we have contacted the participants to find out if they would like to contribute to a White Paper, which will outline possible power supply systems for the Australian SKA and LOFAR sites, and to a demonstrator that will show such a power system for a LOFAR-scale remote station. We have had an enthusiastic response and are now planning the next steps towards these goals.

If you are interested in finding out more about the workshop and ongoing activities in this area we invite you to visit the nascent Australian SKA Consortium Energy Working Group website at *askac.atnf.csiro.au/groups/energy*

George "Nyima" Warr, Peter Hall and Carole Jackson (George.Warr@csiro.au)

SEARFE project report

The SEARFE Project (Students Exploring Australia's Radio Frequency Environment) aims to give senior high-school students practical experience in the value and use of the radio-frequency spectrum, an overview of the scientific objectives of the next generation radio telescopes and a practical understanding of why these telescopes have to operate in radio-quiet areas. The project is in a pilot phase at present, with students at schools in Sydney, Canberra, Narrabri, Kimba (South Australia) and Geraldton (Western Australia) participating in the project. The schools involved in the project are provided with a SEARFE kit, comprising a 0 – 2 GHz receiver, 25 – 1300 MHz discone antenna, laptop computer, receiver control and data logging software, and student and teacher instruction and resource material.

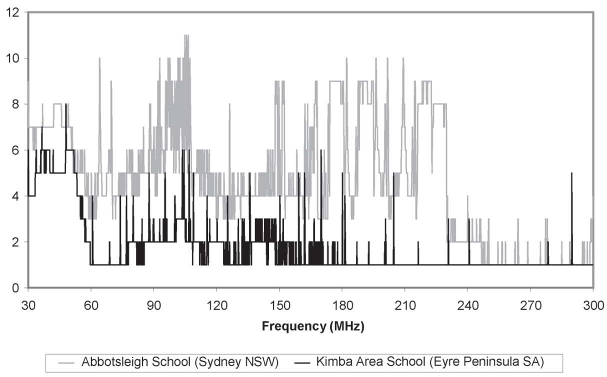


Figure 1: Comparison of SEARFE results collected in urban Sydney, NSW and country Kimba, SA, demonstrating how much more of the spectrum is used in Sydney and how much radio-quieter it is in Kimba. The vertical S-meter scale is logarithmic, with each increment of 1 corresponding to roughly a doubling in received signal strength.

The students have been using the equipment to explore their local radio-frequency environment and posting and comparing their results with other schools via the SEARFE data archive website. Recently the students have been exploring the Very High Frequency (VHF) band (30 – 300 MHz) of the spectrum, which the Low Frequency Array (LOFAR) next-generation radio telescope will operate in. Results contrasting how the VHF band is used in urban Sydney and the remote town of Kimba on the Eyre Peninsula of South Australia are shown in Figure 1.

The SEARFE project has received considerable media attention lately. Channel Ten's Totally Wild programme screened a story on the SEARFE Project on 12 August, which highlighted the work the Sydney Abbotsleigh School students are doing on the project and interviewed the SEARFE Project Co-ordinator: ATNF's Dr George "Nyima" Warr. On 4 August, the Geraldton Guardian ran a story on a presentation the local Nagle Catholic College students made on their work on the SEARFE Project to the delegates of the International SKA Conference 2003 held in Geraldton (Figure 2). The SEARFE Project was on display at the Australian Square Kilometre Array Consortium (ASKAC) stand at the Astro Expo at the International Astronomical Union General Assembly (GA) held in Sydney from 15 – 24 July. During this time Nyima was interviewed by the Sun Herald for an article on radio quiet zones, which appeared on 27 July. The Abbotsleigh School students also presented the project at the School's day held during the Expo and there was a poster presentation on the project at the Assembly and a demonstration of the project at the associated Astronomy Day for Teachers Workshop following the GA.

Leading up to the GA, the SEARFE Project was a major feature in the UNSW-led "Astronomy on the Go" programme that toured more than a dozen schools in regional NSW and several schools in Sydney. Since the Assembly, SEARFE has been on display at the UTS stand, "Science in the City", at the Australian Museum on 17 August and again with UTS in "Science in the Bush" in Tamworth over 25 – 28 August.

Given all this activity, it is wonderful to report that IBM Australia has just donated four new laptop computers to the SEARFE project to enable the project to reach more schools and students. We are investigating using one of these in a SEARFE kit hosted at the Parkes radio telescope Visitors Centre, where there are a high number of school visits and expert staff available to talk about the project and its relation to the next generation radio telescopes. We may well inspire some of these students to go on to design or use these next generation radio telescopes! If you are interested in finding out more about the SEARFE Project please visit the SEARFE website at *www.searfe.atnf.csiro.au*.

George "Nyima" Warr, SEARFE Project Coordinator (George.Warr@csiro.au)

Figure 2: Geraldton Nagle Catholic College students Alice Wenderling, Hoanh Hoang, Adam Harvey and Kylie Judd (pictured) and Candice Woodhams and Maree Altham (out of frame) explaining their work on the SEARFE Project to International SKA Steering Committee chair, Jill Tarter (left), and other conference delegates at the International SKA Conference 2003 in Geraldton.

All over bar the accounting: IAU GA25

Organizational aspects of the General Assembly

The Sydney meeting of the 25th General Assembly of the International Astronomical Union is now well and truly over, and what a meeting it turned out to be! Held during the period 13 – 26 July at the Sydney Convention and Exhibition Centre in Darling Harbour, even the Gods were on-side – the weather was superb and Sydney and its Harbour could hardly have been more inviting.

The National Organizing Committee (NOC) now has the difficult task of taking stock of the meeting and its organization, in particular establishing what should have been done better. As NOC Co-Chairs we are in the process of producing a final report of the General Assembly (GA), and will send copies to the organizers of the 2006, 26th General Assembly in Prague in the hope that they can benefit from our experiences and avoid our mistakes.

It is amazing that the our complex General Assembly occurred with so few problems - with its six Symposia, 21 Joint Discussions, four Special Sessions, three Invited Discourses, and Working Group, Division/Commission and ad-hoc meetings, not to mention an Astro Expo, and set of daily and longer tours. Added to this were a spectacular evening reception and opening in the Sydney Opera House, a final General Assembly "Party", a "Festival of Astronomy" for the public (public talks, a "Schools Day" and "Astronomy on the Go" activities organized by the University of NSW, "Science in the Pub" [Figure 1], and other events), and a special Industry Day.

The final meeting statistics are still being put together, but they appear to be extremely pleasing. The participant list included:

- 1830 IAU members and invited participants;
- 263 registered guests and children;
- 94 student-volunteers assisted with the organization;
- 68 media and exhibitors;
- 24 teachers attending a special session on education;
- 21 lighting engineers attending a working group meeting on light pollution; and
- 125 attendees at a special Industry Day meeting.

Countries with over 100 participants were USA (632), Australia (388), Japan (145), China (136), UK (131), Germany (117) and France (104). In all, 66 countries plus autonomous regions of China were represented.

A satisfactory financial outcome was possible with the generous support from the Australian Federal Government, and by the two major sponsors CSIRO and Connell Wagner. In addition, AARNeT and GrangeNet provided support for the internet traffic, Gruber Foundation for the Opening Ceremony, and Sydney's Lord Mayor for a reception. The UNSW, Donovan Trust and British Council provided support for the associated events. Significant travel grant support for participants was provided by the European Southern Observatory and NASA in addition to the IAU travel grants.

Some other general features of interest were:

- The GA Opening Ceremony was held in the Concert Hall of the Sydney Opera House on 15 July. The ceremony included an organ recital by Australia's chief scientist Robin Batterham, the first formal presentation of the Gruber cosmology prize (to Rasheed Sunyaev) as part of the IAU GA and other events (Figure 2).
- At the Closing Ceremony on 24 July , Ron Ekers of ATNF became IAU President for the period 2003 – 2006.
- A student-volunteer program was established in which university students participated in the GA operation. In return for assistance equivalent to five days' work 94 students participated in the GA for a reduced registration fee.
- A Conference Centre exhibition hall was used as a communal area for the GA participants. It also contained the Astro Expo, poster presentations, internet café, 150-seat theatrette, café and childcare centre.
- No restriction was put on the number of poster presentations approved by the scientific organizing committees of the various meetings, and the final number exceeded 1360. This was more than originally planned, and some posters had to be displayed in foyers outside Convention Centre meeting rooms.

- Childcare facilities: for children younger than five years a "creche" was provided in the exhibition hall; older children were looked after by a group of student childcare teachers from the University of Technology Sydney, who took them on various tours around Sydney etc.

- Internet access was provided by an internet café including 40 PCs and 48 laptop connection points. Extensive wireless internet access was provided throughout the Convention Centre by CSIRO staff from Telecommunications and the ATNF.

Figure 1: One of the "Science in the Pub" sessions associated with the GA. The picture shows Fred Watson playing the guitar. The other speaker for the event was David Malin.

- An Astro Expo was organized for the benefit of both participants and the general public; it contained 45 individual displays. Part of the exhibition was an "Australia Pavilion", aimed at presenting Australian science to an international audience. It was funded by a grant for international showcasing from the Commonwealth Department of Education, Science and Training.

- An "Industry Day" was funded by the Commonwealth Department of Industry, Tourism and Resources, consisting of a one-day workshop held in the Exhibition Hall theatrette on 23 July; the attendance included 125 representatives from 75 organizations. Presentations on the needs for future astronomical instrumentation, and opportunities for industry were made by an international group of IAU participants.

- Daily issues of a newspaper "The Magellanic Times" edited by Seth Shostack from The SETI institute were published during the GA. Some copies of the newspaper are still available from Helen Sim at ATNF *(Helen.Sim@csiro.au)*.

- A media campaign was launched for the GA and the Festival of Astronomy on 19 June at Sydney Observatory.

- Helen Sim (ATNF and Anglo-Australian Observatory [AAO]) ran a very active press office throughout the GA.

Several matters kept us extremely nervous during the last year of organization. One concerned a prolonged international unrest that threatened to limit the number of participants from overseas, following the September 11 disaster and subsequent terrorist alarms, October 2002 Bali bombing, Iraq war and SARS outbreak. Another was the impact of registration fees (AUD 880 including GST) higher than for previous GAs, required to balance the high venue costs. With costs of international travel also taken into account, and the increasing value of the Australian dollar against many other currencies over the last year, many astronomers were concerned at the high cost of attending the Sydney meeting. Up until the last few weeks before the meeting the budget was a major concern.

Remarks on the early General Assembly organization

It is appropriate to reflect on the early history of the GA organization. The gestation time was almost a decade. In the early 1990s, Don Mathewson, then a member of the IAU Executive, spearheaded a move for an Australian IAU GA. It was initially proposed that the meeting be held just prior to the Sydney Olympic Games in 2000, but fortunately commonsense prevailed and a 2003 date was subsequently proposed. Following strong initiative from Jeremy Mould, at that stage recently appointed Director of Mount Stromlo and Siding Spring Observatories (MSSSO), and major input from Sandra Harrison (then at the AAO), a bid was developed and submitted to the IAU Executive in 1995. The success of the bid was announced at the Kyoto IAU General Assembly in 1997.

John Norris (MSSSO) convened the first meeting of an organizing committee. A number of different people held the Chair of the NOC leading up to the

Figure 2: The Descendance dance group performing in the Opera House at the Opening Ceremony of IAU GA25.

GA: John Norris, MSSSO; Lawrence Cram, Sydney University; Raymond Haynes, ATNF; and Harry Hyland, James Cook University. In April 2002, John Whiteoak of ATNF joined Harry as Co-Chairs of the local organizing committee. The Astronomical Society of Australia (ASA) agreed to take on the financial responsibility for the GA with the National Committee for Astronomy as the formal adhering body to the IAU.

Epilogue

Hosting the GA in Australia has required a considerable effort and huge financial cost. To estimate the true cost to the astronomy community account must be taken of the loss of scientific productivity over several years for many people who have been involved in the organization, plus the associated salary costs of these people, and the other costs absorbed by institutions – travel to GA-associated meetings, cost of meeting support (e.g. cost of teleconference calls, secretarial support etc).

So what have been the benefits to Australia apart from the obvious financial benefit of having some 2000 visitors spending two weeks in Sydney? Prestige of being chosen as hosts? We have managed to take advantage of having the world's astronomers on our doorsteps to publicise Australian astronomy more than usual through the exhibition displays (Australia Pavilion), Industry Day, Observatories Tour and sessions on the history of Australian radio astronomy. The events have brought the attention of the Federal Government to the place of Astronomy in Australian and international science. One important bonus was the opportunity provided

Science at the IAU

Scientifically, the General Assembly appears to have been an outstanding success. Attendees had the luxury of attending up to six symposia, the scientific showpieces of the event, and 21 Joint Discussions, as well as various other special sessions and events. The main disappointment was that it was only possible to listen to a fraction of the interesting talks, and to read a small number of the interesting posters. Many ATNF staff were involved in the organization of the scientific programmes. Four of the symposia had ATNF co-chairs or SOC members (IAU216 Maps of the Cosmos; IAU217 Recycling intergalactic and interstellar matter; IAU218 Young Neutron Stars and their Environments; IAU220 Dark Matter in Galaxies). Their duties continue as the deadline for the submission of conference papers has passed, and proceedings have to be published! Those attending the General Symposia were treated to some excellent talks, excellent weather and an excellent venue. Highlights were many, and to name a small number would do injustice to the many others. But owing to the wide-ranging knowledge of many audience members, many of the review talks were well-received - for example, the series of reviews on the Cosmic Microwave Background and the Dark Matter problem. As the attendance was so good, in the end, it was possible to renew many old acquaintances and to meet new people and form new collaborations. Undoubtedly, the General Assembly was also an excellent place to showcase Australian astronomy, and we look forward to reaping the scientific benefits over the coming years!

Lister Staveley-Smith
(Lister.Staveley-Smith@csiro.au)

for Australian astronomy students to participate in a GA. The Australian public had the opportunity to learn more about astronomy via the Astro Expo, public talks, other associated events, and increased media publicity. Free or discounted participation was provided to non-astronomers with particular interest in some of the sessions. These included Australian lighting engineers and the Commission-50 working group meeting on controlling light pollution, teachers and people with a special interest in the Australian history sessions (e.g. grandchildren of pioneer radio astronomer, J. L. Pawsey).

In all, could we have done better? Maybe.

John Whiteoak
ATNF Honorary Fellow & Co-Chair, NOC

Harry Hyland
Deputy Vice-Chancellor James Cook University & Co-Chair, NOC

Ron Ekers
Federation Fellow & IAU President

(John.Whiteoak@csiro.au)
(Harry.Hyland@jcu.edu.au)
(Ron.Ekers@csiro.au)

History of radio astronomy at the IAU General Assembly

Given Australia's pioneering efforts in international radio astronomy, it was only natural that Commissions 40 (Radio Astronomy) and 41 (History of Astronomy) should combine and offer a day and a half of historic radio astronomy sessions at the recent Sydney IAU General Assembly (GA).

A motley mix of about 140 radio astronomers (past and present), astronomical historians, and others gathered on Monday, 21 July for an all-day science meeting on "The Early Development of Australian Radio Astronomy". This featured 15 oral papers and a poster paper, for the most part about the work at the various Division of Radiophysics field stations and at Parkes, although there was an excellent review paper about the Molonglo Cross. Apart from an introductory overview by Woody Sullivan, all of the papers were prepared by retired radio astronomers who were actively involved in Australian radio astronomy at one time or another during the period 1945 – 1988. In addition, a video about Grote Reber was screened during lunchtime. This science meeting was organized by Miller Goss, Dave Jauncey, Ken Kellermann, Wayne Orchiston (Co-Chair), and Woody Sullivan (Co-Chair).

For those wanting yet more, Tuesday, 22 July included a half-day science meeting on "Pioneering Observations in Radio Astronomy" organized by Wayne Orchiston and Bruce Slee, which also attracted an audience of about 140. The eight oral papers and three poster papers spanned early radio astronomy developments in Australia, France, Japan, Russia and Sweden. Presentations about the "founding father" of radio astronomy, Grote Reber, and the first two female radio astronomers, Elizabeth Alexander (NZ) and Ruby Payne-Scott (Australia) were particularly well received.

One other development worth mentioning that occurred during the GA was the formation of a new C40-C41 Working Group on "Historic Radio Astronomy". This will aim to identify, document and where feasible preserve surviving historically-significant radio telescopes and ancillary instrumentation world-wide. The WG committee comprises: R. Davies (U.K.), J.-F. Denisse (France), K. Kellermann (USA), M. Morimoto (Japan), W. Orchiston (Australia – Chair), S. Slysh (Russia), G. Swarup (India), and H. van Woerden (Netherlands).

Wayne Orchiston (ATNF)
(Wayne.Orchiston@csiro.au)

ATNF outreach

New outreach appointments

It is a pleasure to announce two recent outreach appointments. John Smith joined the ATNF in late August to take up a position as the Manager at the Parkes Visitors Centre and Coordinator of the Parkes and Narrabri Visitors Centres. John has a Bachelor of Science/Bachelor of Arts degree in Science Communication, a Graduate Diploma in Scientific Communication and a broad range of experience in science communication. In his previous career he has presented science shows and exhibitions around Australia, provided scientific research and support for a children's television program and developed and presented educational programs for the CSIRO Science Education Centre in Brisbane. More recently, John has worked for CSIRO as a Multimedia and Visual Resources Officer and as a Web Communication Officer. John is based at Parkes but will make regular visits to Narrabri to support Narrabri outreach activities and the Narrabri Visitors Centre.

Rob Hollow arrived in early October to take up a new position as Education Officer in the National Facility Support group. Rob has a Bachelor of Science degree with a major in Physics, a Graduate Diploma in Secondary Education and considerable experience in science and astronomy education after working as a high school science teacher for many years. He has been strongly involved with science curriculum development and was the principal writer for the astrophysics course currently taught to senior high school students in New South Wales. Rob is also one of the writers for a Cosmology Distinction Course for gifted students. As the ATNF Education Officer, he will develop and promote educational resources in astronomy. Over the next few months we plan to develop internet-based astronomy materials for high schools, to build up a public talks program and to set up workshops for teachers.

Jessica Chapman
(Jessica.Chapman@csiro.au)

Symposia and workshops – November 2003 to March 2004			
Event	**Date**	**Location**	**Web Information / Contact**
Australia Telescope Users Committee meeting	3 – 4 November 2003	ATNF Marsfield Lecture Theatre	*Vincent.McIntyre@csiro.au*
Structure and Dynamics in the Local Universe	24 – 26 November 2003	Little Bay Conference Centre, Maroubra, NSW	*www.aao.gov.au/Tully/*
Australian – Virtual Observatory workshop	17 – 18 November 2003	ATNF Marsfield Lecture Theatre	*www.aus-vo.org/vo2003*
Millimetre Science Workshop 2003: Strategic Directions for the ATCA and Mopra	8 December 2003	ATNF Marsfield Lecture Theatre	*www.atnf.csiro.au/whats_on/workshops/mm_science2003/*
Australian SKA Simulation meeting	9 December 2003	ATNF Marsfield Lecture Theatre	*Maxim.Voronkov@csiro.au*
Planetary Timescales: From Stardust to Continents. Elizabeth and Frederick White Conference	16 – 19 February, 2004	Australian Academy of Science, Canberra	*www.mso.anu.edu.au/PSI/white_conference.html*

Marsfield Engineering Development Group report

The last few months have been a very busy time for the group with a number of major instruments being installed, or shortly due for installation, at both Narrabri and Parkes.

The completion of the 12-mm system at Narrabri in June was quickly followed by the delivery of a new 8-GHz receiver at Parkes in August. This receiver was built under contract to NASA as part of the upgrade to Parkes for tracking of spacecraft heading for Mars. The final performance of the Parkes telescope turned out to be considerably better than the NASA specifications, due largely to the excellent performance of the receiver.

A new wide-band analogue correlator system is being prepared for installation at Narrabri in early October. This will replace the 4-GHz bandwidth single-baseline system used last year with an 8-GHz bandwidth three-baseline-system. The new system makes full use of the maximum bandwidth available from the new 12-mm receivers and should result in a significant increase in sensitivity. An interesting feature of the new system is the use of ATNF designed wide-band analogue multipliers, developed under the Executive Special Projects program. These devices were fabricated using the TRW indium phosphide (InP) hetero-junction bipolar transistor (HBT) process and are the second application of this process in ATNF instruments. The first was the use of fast 2-bit sampler circuits in the Parkes wide-band correlator system. Both of these circuits were developed by Paul Roberts who has also done the design of the 16-lag correlators. Each correlator has 16 InP analogue multiplier chips fed from splitter/delay line circuits to provide measurements of the degree of correlation of the input signals at 16 different delays (Figure 1).

The three-baseline system will use three ATCA antennas spaced at 30-m increments. Like the single-baseline system from last year it will operate in a meridian transit mode, thereby avoiding the difficult problem of providing continuously variable delays on the 8-GHz bandwidth analogue IF signals.

Another major installation comes later in October when the new dual-band 10/50-cm pulsar receiver is due for delivery to Parkes. The new receiver, together with the wide-band pulsar correlator, will provide a 1-GHz bandwidth capability for pulsar observations at 10-cm wavelength.

Other major projects keeping us busy at the moment are the 3-mm upgrade for the ATCA, the 21-cm multibeam receiver for Arecibo and the 8-GHz spectrometer for Mopra. All of these are due for delivery over the next year.

Warwick Wilson
(Warwick.Wilson@csiro.au)

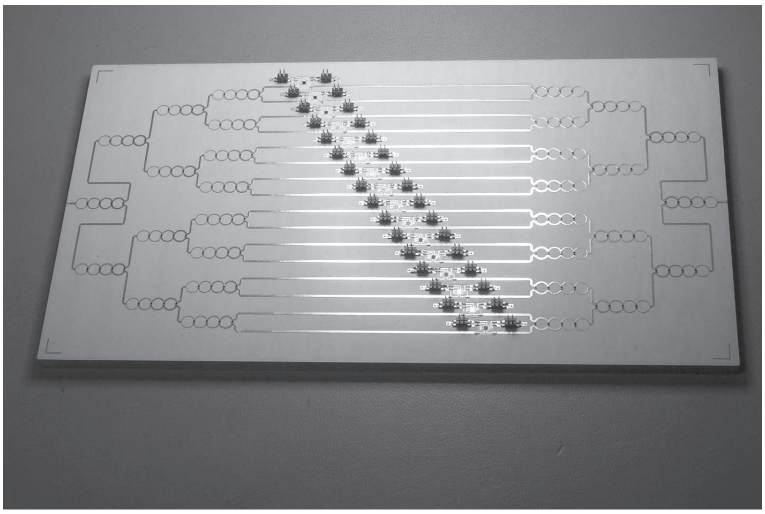


Figure 1: The 8-GHz analogue correlator

aips++ to the rescue

As part of a project to investigate milli-arcsecond scale morphological differences between scintillating and non-scintillating flat spectrum radio sources we needed to do something that seemed fairly simple: display the same image using, simultaneously, two different kinds of contours. This was needed to indicate the location of a "fiducial" contour that was defined as a fraction of the peak flux and was to be used as an indication of how extended a source is. The sources in this sample have very weak extended structure for which the traditional model fitting method (typically using the Modelfit program from the Caltech Difmap package) does not yield objective results.

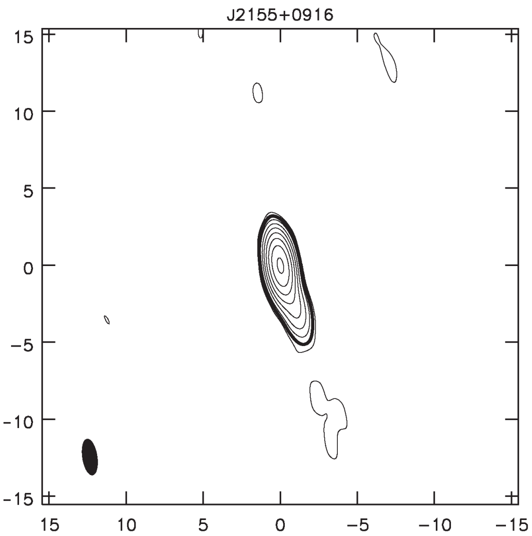


Figure 1: Total intensity plot of the scintillating extragalactic radio source J2155+0916. Thin contours are in steps of 2 with the lowest contour at 0.3-sigma. The single thick "fiducial" contour indicates 2 % of the peak flux.

To our surprise, we were unable to find a way to do this using the traditional astronomy packages we were familiar with. We discovered, however, that it is possible to do this using aips++. Malte Marquarding and Neil Killeen of the aips++ group immediately wrote a script to produce an image which could display two different kinds of contours where the contours can be distinguished in various ways such as width and colour. Having achieved our basic requirement Malte has greatly expanded the original script to one that generates all our total intensity, polarization and fractional polarization plots for this project. This script is designed for batch processing

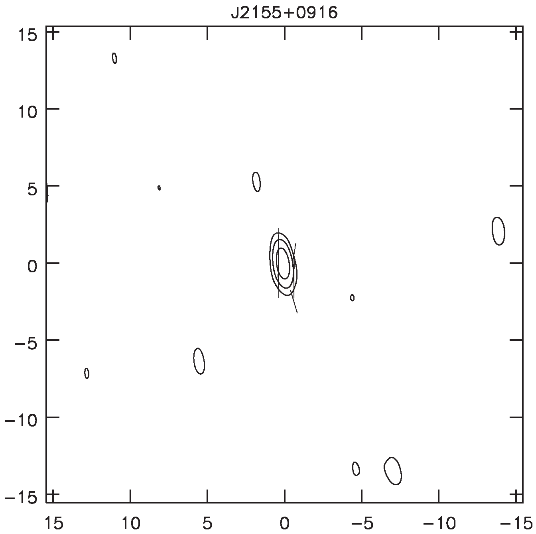


Figure 2: Polarized intensity contours for J2155+0916. Contours are in steps of 2 with the lowest contour at 3-sigma. The tick marks indicate the direction of the electric vector position angle. Their spacing and length have no significance.

large numbers of sources while still providing interactive modification for individual sources. This does at least everything that AIPS can and does so with greater flexibility and, arguably, ease of use. The high level of prompt support from the ATNF aips++ group has eased our transition to the use of aips++.

Roopesh Ojha
(Roopesh.Ojha@csiro.au)

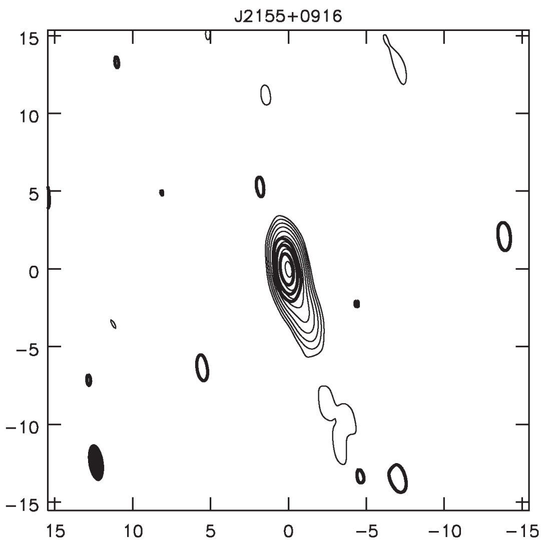


Figure 3: Fractional polarization plot for J2155+0916. The thin contours show total intensity exactly as in Figure 1. The thick contours show the polarized intensity as in Figure 2.

ATNF graduate student program

Three new PhD students have recently joined the ATNF co-supervision program:

- Patrick Ramsdale (University of Tasmania) has started a PhD project titled “Multi-transitional Studies of OH and Methanol Masers” with supervisors Dr Simon Ellingsen (University of Tasmania) and Dr Jim Caswell (ATNF).

- Douglas Hayman (Macquarie University/ ATNF/ICT) has started a PhD project titled “Densely Packed Focal Plane Arrays” with supervisors Dr Karu Esselle (Macquarie University), Dr Trevor Bird (ICT) and Dr Peter Hall (ATNF). Doug is a CSIRO employee having worked with the antennas group (which is now part of the CSIRO Information and Communication Technologies Centre) for many years and was associated with design and measurement of the Parkes 21-cm multibeam system.

- Suzy Jackson (Macquarie University/ATNF) has started a PhD project titled “Integrated Systems for Next Generation Telescopes” with supervisors Dr Jeffrey Harrison (Macquarie University) and Dr Peter Hall (ATNF). Suzy is also a CSIRO employee presently in the SKA group, but having gained a fine reputation in the Engineering Development Group (Receivers) by developing interfacing hardware for receivers and conversion systems.

Finally, best wishes to two University of Adelaide PhD students, Hayley Bignall and Melanie Johnston-Hollitt, who have both been officially awarded their degrees. Hayley’s PhD thesis title is “Radio Variability and Interstellar Scintillation of Blazars”. Melanie’s thesis title is “Detection of Magnetic Fields and Diffuse Radio Emission in Abell 3667 and other Rich Southern Clusters of Galaxies”. Both now have postdoctoral positions in the Netherlands (JIVE and Leiden, respectively).

Lister Staveley-Smith
Graduate student coordinator
(Lister.Staveley-Smith@csiro.au)

Distinguished visitor program

Around the time of the IAU General Assembly, we enjoyed the company of several visitors who extended their stay in Australia under the auspices of the ATNF and Federation Fellow distinguished visitor program.

They were Joe Taylor (Princeton University, USA), V. Radhakrishnan (Raman Research Institute, India), Rajaram Nityananda (NCRA, India), S. Ananthakrishnan (GMRT, India), Ken Kellerman (NRAO, USA) and Jayanne English (University of Manitoba, Canada). Currently we also have Ned Ladd (Bucknell University, USA) visiting the ATNF and University of New South Wales for a year, and are shortly expecting Brent Tully (Institute for Astronomy, Hawaii) for a few weeks.

Whilst in Australia, most visitors are encouraged to give colloquia at University departments. The visitors program is now chaired by the Director, and prospective visitors are advised to get in touch with their staff collaborator or the Director. Details can be found at *www.atnf.csiro.au/people*.

Lister Staveley-Smith
(Lister.Staveley-Smith@csiro.au)

Compact Array millimetre observations of η Carinae

Background

η Carinae is one of the more remarkable objects in the southern sky. Located 2.5 kpc away in one of the Galaxy's most prolific high mass star-forming regions, the Carina Nebula, it underwent an outburst in the 1830s that transformed it from the fifth brightest star in Carina to the second brightest star in the whole sky (magnitude -1). It faded from naked-eye visibility over the next 100 years, but in the 1960s it regained notoriety when it was found to be the brightest (extra-solar system) infrared source in the sky at 10 and 20 μm: the prodigious luminosity previously emitted at optical wavelengths is now absorbed by dust near the star and re-radiated in the infrared. Recently it has been found to be brightening again in the optical (Davidson et al., 1999). At various times it has been explained as a massive pre-main-sequence star, a slow supernova, an accretion-powered source, and a point source of cosmic rays embedded in dust.

The prevailing view for the last 20 years has been that η Carinae is the most extreme member of the class of stars known as "Luminous Blue Variables" (LBVs). These are thought to be evolved massive stars in a short-lived state prior to becoming Wolf-Rayet stars: during this state they shed their outer layers, producing spectacular nebulae. Only a few LBVs are known in our Galaxy. η Car's outburst in the 1830s produced a beautiful dumbbell-shaped nebula, called the "Homunculus", about 17-arcsec long and still growing. As a single star, η Car's bolometric luminosity of $10^{6.5}$ $L_{\odot}$ would make it possibly the most luminous and therefore most massive star in the Galaxy.

η Car has its own dedicated band of astronomical groupies who meet every few years to drool over the latest excesses uncovered by better and better instruments. Despite all this attention, it was not until about seven years ago that Brazilian astronomer Augusto Damineli realized that some broad optical lines from η Car showed a 5.5-year cycle. This quickly led to the idea that η Car might not be a single 100 $M_{\odot}$ star after all, but rather a binary of two very massive stars in a highly elliptical orbit (Damineli et al., 1997). The primary is an LBV while the companion is apparently a less evolved but hotter star, both with masses in the 40 – 70 $M_{\odot}$ range.

Despite a lot of early scepticism of the binary model (some of which continues), evidence rapidly began to mount in its favour. Coincidentally, X-ray (Corcoran et al., 1995) and radio (Duncan et al., 1995) monitoring of η Car had started a few years earlier and was showing unexpected variability. Damineli predicted a new spectroscopic event at periastron of the binary in early 1998, and a coordinated observing campaign confirmed the periodicity. The X-rays showed a steady rise to a peak as the system approached periastron and then a sudden drop by a factor of 10 to a very low level that lasted for two months (Ishibashi et al., 1999), while the radio showed a quasi-sinusoidal light curve with a very broad peak at apastron and a minimum at periastron (Duncan et al., 1997). These behaviours are attributed to two very different causes: the X-rays are due to a shock where the powerful winds of the two stars collide, and should get brighter near periastron as the distance between the two stars diminishes and the density in the shock goes up. The drop at periastron occurs when the LBV passes in front of the hot star and its dense neutral wind obscures the shock region. The radio emission has a very different source: it is due to free-free emission from gas in the outflow from the LBV that is ionized by ultraviolet photons from the hot companion. However, every 5.5 years when the binary orbit causes the evolved star to pass close to the hot star, the dense LBV wind absorbs all the ultraviolet light and shuts off the supply of ionizing photons to the gas, which is dense enough to recombine (becomes neutral again) on a short timescale and thus ceases to emit radio waves. As the evolved star moves further on its orbit, the hot star is revealed once again and the process starts all over.

Compact Array millimetre observations

With this background, we looked forward with great excitement to the opportunity to use the Compact Array at millimetre wavelengths during the periastron event in 2003 (roughly coinciding with the IAU GA!).

Millimetre wavelengths allow us to address a number of aspects of this system that complement the results of the long-term microwave monitoring with the Compact Array, particularly by taking advantage of the superior spatial resolution and ability to look deeper into the system (because the height of the optically-thick surface in a stellar-wind radio source scales with radio frequency ν as $\nu^{-0.7}$). A European group used the SEST telescope to look at the millimetre emission of η Car and found several remarkable results: at $\lambda = 3$ mm the flux of η Car was found to be 10 – 20 Jy, which is an extraordinary continuum level; it varied with the 5.5-year cycle; and in addition η Car was found to exhibit strongly masing recombination lines (Cox et al., 1995; Cox, 1997). Theory says that such masing recombination lines require regions of very high density where collisions overpopulate the upper energy levels of hydrogen atoms (Strelnitski et al., 1996), so an obvious source for the line is the wind of the LBV. This offered the prospect of measuring the velocity shift in the LBV on either side of periastron and providing definitive support for the binary hypothesis if a change in velocity should be detected. The SEST-data are single-dish measurements and contain no information on the spatial structure of the source, but we knew from the microwave observations that the source region would be just a few arcseconds across, perfectly matched to the Compact Array's longer configurations. With periastron predicted (correctly, as it turned out) for June 2003, we requested observations at both 12 and 3 mm in early May and early August, on either side of periastron. Based on models for the binary orbit, the LBV should show a velocity change of order 50 km/s, easily detectable at both wavelengths.

η Car is a wonderful millimetre source, with a large flux packed into a very small region, making it ideal for self-calibration and therefore less susceptible to atmospheric problems than weaker sources. Only three antennas were available at 3 mm but all six antennas were outfitted with the 12-mm receivers for both of our observations. With the exception of one very brief period in the middle of an afternoon, none of our data showed atmospheric decorrelation of the amplitudes and it produced excellent results.

Figure 1 summarizes the results of the 3-mm observations. The three-antenna data are consistent with a source smaller than 1 arcsecond. In May the continuum flux was 8.6 Jy and the recombination line

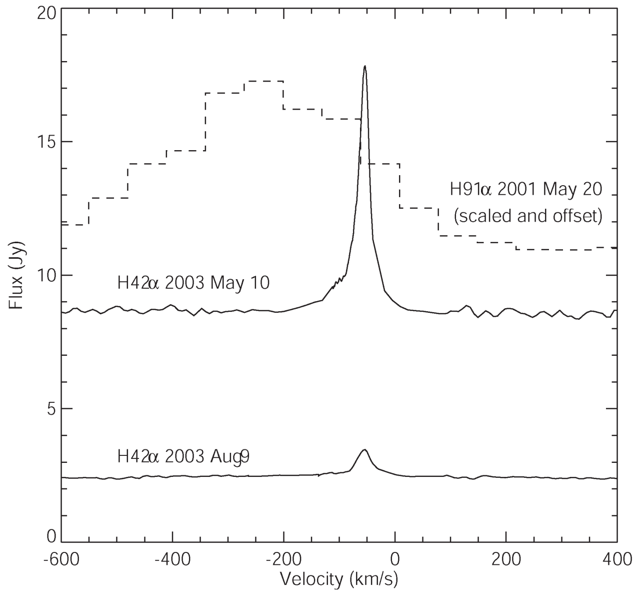


Figure 1: Compact Array observations of the H42α recombination line (85.688 GHz) and continuum spectrum of η Carinae obtained with the 3-mm receivers on either side of periastron in May and August, 2003 (solid lines, labelled). Two correlator settings are required to achieve the broad velocity coverage. The flux scale is correct to better than 10%. For comparison, we show the microwave recombination line H91α (8.585 GHz) spectrum in 2001 (dashed), near apastron for the system, arbitrarily shifted and rescaled for the plot. The other famous masing recombination line source, MWC 349, shows two peaks in the spectrum, spatially offset from one another and apparently from opposite sides of a disk surrounding a hot star, very different from the single peak exhibited by η Car.

was 8 Jy brighter, dominated by the feature at -55 km/s (i.e., blue-shifted). By August the continuum level had dropped by about a factor of over 3 to 2.4 Jy, but the line flux fell even more dramatically, by almost a factor of 10. However, the velocity of the line showed no change: it was still centered at -55 km/s. Our results do not show a velocity shift consistent with motion of either the LBV or its companion around their orbits. For comparison, Figure 1 also shows the microwave recombination-line spectrum at apastron: it is very different from (and much weaker than) the millimetre spectrum, with a feature 500 km/s wide centered at about -250 km/s. The microwave spectrum is dominated by optically-thick gas at large distances from the system, blueshifted because it is flowing out from the stars and lies between us and them. This gas becomes optically thin at higher frequencies and is not visible in the millimetre emission, which reveals instead a bright source closer to the stars.

The dramatic changes in flux levels at 3-mm wavelength are consistent with the SEST results and

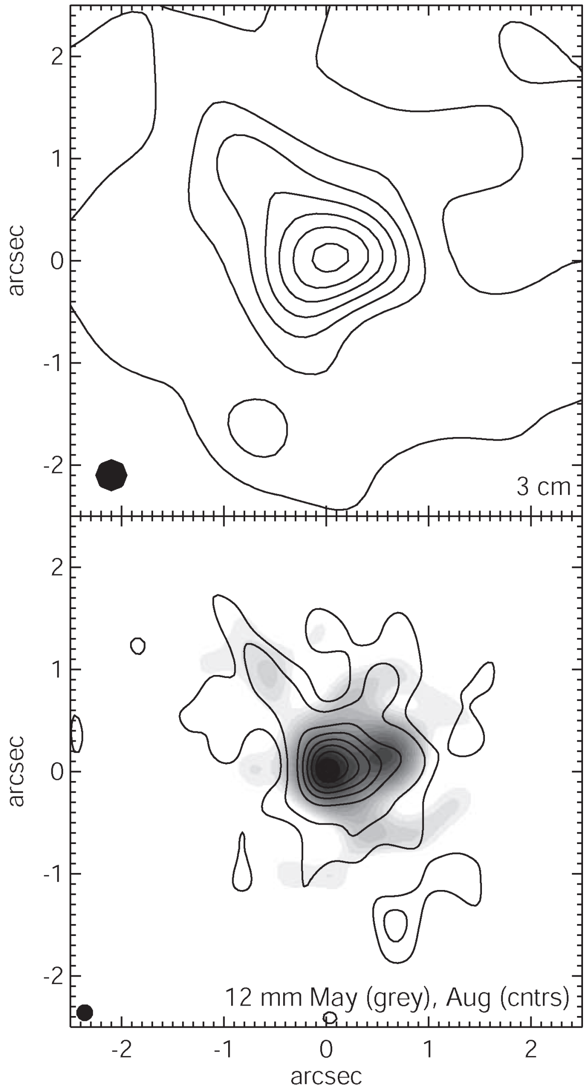


Figure 2: Compact Array images of the continuum emission from η Carinae at 3 cm in 2003 August (upper) and at 12-mm (lower: 2003 May image in greyscale, August in contours) wavelengths. These are super-resolved images deconvolved using maximum entropy with restoring-beam sizes as shown in the bottom left corner (0.3 arcsec at 3 cm, 0.15 arcsec at 12 mm). Contours are at intervals of 2, 5, 20, 35, .., 95% of the maxima (32 mJy/beam at 3 cm, 61 mJy/beam at 12 mm). At the normal resolution (0.7 x 0.4 arcsec) the August 12-mm image has a peak-to-rms ratio of almost 2000.

with 7-mm measurements from the Itapetinga single-dish telescope in Brazil, but are very difficult to reconcile with a stellar wind model. The LBV, with its slower but more massive and hence much denser wind, should be a very bright radio source if its wind is ionized. However, assuming that ionization in the wind is due to the LBV's own radiation field, there is no reason for it to vary dramatically with orbital phase. On the other hand, if the millimetre continuum source is a region of the dense LBV wind ionized by the hot companion (as in symbiotic stars), its flux should diminish at apastron when the companion is far away, which is the opposite of the observed behaviour. Since everything else in the system seems to fit the binary model so well, we conclude that the recombination line source does not lie in the wind of either star. There are other discrete dense gas concentrations known to exist within the central 1 arcsec of the system (the projected size of the binary orbit is about 5 milli-arcseconds), but none of them have the right velocity, and it is hard to understand how they could be brighter in the radio than the LBV stellar wind. Note that the hot companion in the system has never been detected directly at any wavelength.

The recombination line is also masing at 12 mm and velocity measurements at that wavelength support the 3-mm results. However, much less change from May to August is seen in the 12-mm fluxes, which dropped about 30%. This implies that the millimetre spectrum of η Car changes slope significantly near periastron. With six antennas and plenty of flux, we can take advantage of super-resolution techniques to achieve sub-arcsecond imaging at 12 mm. Figure 2 compares the 12-mm image at 0.15-arcsec resolution in August with an image at 3 cm obtained a few days earlier and with the 12-mm image in May (greyscale). The 12-mm images are much more centrally condensed than the 3-cm image, although they also exhibit some of the fainter outlying features present in the 3-cm image, such as the faint linear feature pointing to the north-east. This central condensation at the shorter wavelength is consistent with the expected picture in which the size of the optically-thick surface decreases with wavelength such that we see deeper into the central region of the source. However, the 12-mm image is still clearly extended at the resolution used in Figure 2. In May a discrete peak is seen 0.6 arcsec to the west of the brightest peak, and in August this western source appears much weaker, while the main peak is almost unchanged, suggesting that it may be a stable stellar-wind source.

These observations demonstrate the power of the new millimetre receivers on the Compact Array: sensitive sub-arcsecond images of southern sources can readily be achieved. However, they have only deepened the mystery surrounding η Carinae. We look forward to having five antennas outfitted with 3-mm receivers to allow us to peer even deeper into the central region. As the system recedes from perihelion, the millimetre fluxes will again grow and the images will reveal the distribution of gas that becomes ionized as the LBV departs.

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Stephen White, Bob Duncan, Jessica Chapman and Baerbel Koribalski
(Stephen.White@astro.umd.edu)

The highest resolution image from the Compact Array: SNR 1987A at 12 mm

Obtaining high-resolution images of the radio remnant of SN 1987A to compare with the resolution of the Hubble Space Telescope and Chandra was one of the principal scientific justifications for the 12-mm upgrade of the Compact Array in the 1995 Major National Research Facilities proposal. Eight years later, this goal has finally been achieved. Although three antennas were fitted with 12-mm prototype receivers in September 2001 and we detected the remnant a few weeks later, it was not until April 2003 that 12-mm receivers were installed on all six antennas of the array, giving the 6-km baselines needed for sub-arc-second imaging.

SN 1987A, located in the 30 Doradus region of the Large Magellanic Cloud, was the brightest supernova in nearly 400 years. The supernova was first observed optically on 24 February 1987, a few hours after the explosion, and quickly brightened to about 4th-magnitude. The first radio observations commenced just one day later at Molonglo and Fleurs, at 843 and 1400 MHz respectively, and two days later with the Parkes-Tidbinbilla Interferometer at 2.3 and 8.4 GHz (Turtle et al., 1987). These observations showed a radio burst which reached about 120 mJy in one or two days and then decayed with a timescale of a week or so to become undetectable after a few months. This “radio supernova” phase was very short-lived and under-luminous compared to similar events seen in other more distant galaxies, almost certainly because of the tenuous atmosphere of the exploding star. However, a different “supernova remnant” (SNR) phase of emission was expected when the supernova shock began to plow into circumstellar gas, so monitoring continued at Molonglo and commenced at the newly commissioned Compact Array. Some models predict that the remnant will become very bright when the shock reaches the dense gas seen as the bright inner ring in, for example, Hα images.

Renewed emission was first detected at Molonglo in July 1990, and a few weeks later at the Compact Array. This emission has grown in intensity more-or-less steadily since then and now has a flux density of about 300 mJy at 843 MHz and 200 mJy at 1.4 GHz (Ball et al., 2001; Manchester et al., 2002). It has a power-law spectrum with a spectral index of about -0.9, signifying an optically thin synchrotron source. This spectral index is steeper than the average SNR but the spectrum appears to be getting flatter with time and will have the average index of about -0.5 in just 50 years if present trends continue. By mid-1992 the remnant was strong enough to image at 3 cm with the Compact Array, and images have been obtained at roughly yearly intervals since then. With normal diffraction-limited restoration, these images have a resolution of about 1 arcsec and they barely resolve the SNR. However, use of “super-resolution”

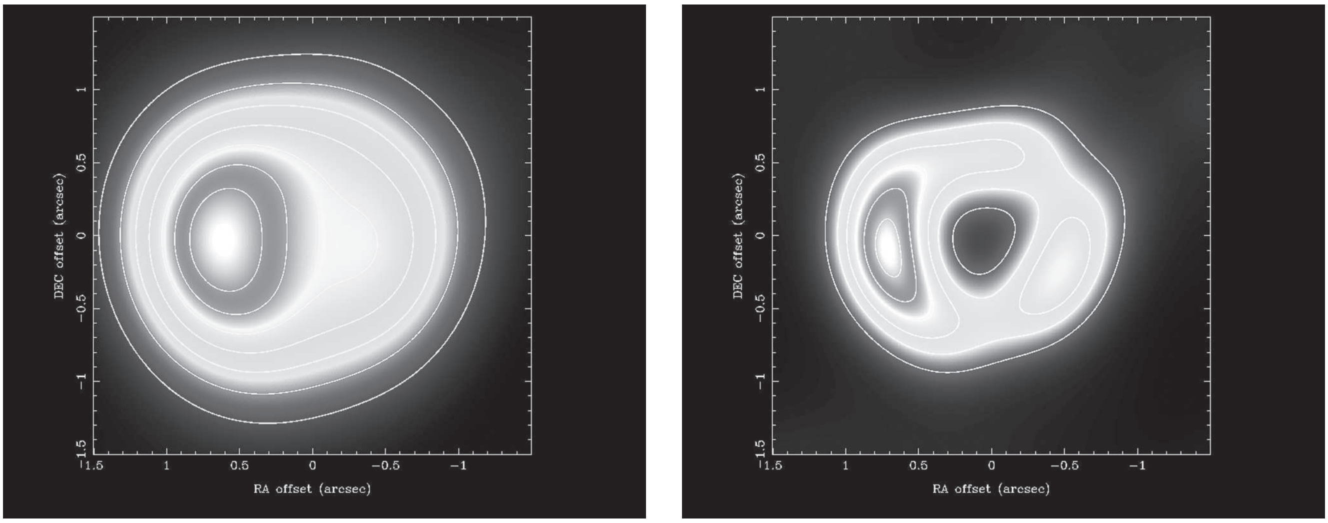
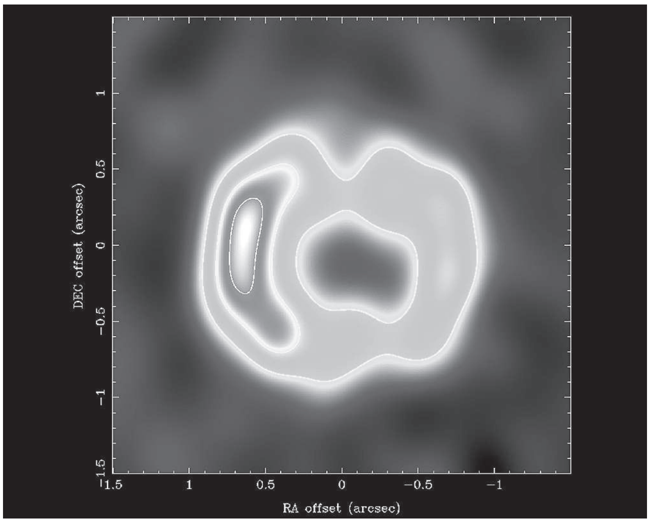


Figure 1: (a) Diffraction-limited 3-cm image of the radio remnant of SN 1987A obtained on 1 August, 2003 using the Compact Array in the 6D configuration. (b) Super-resolved image obtained using the Miriad "maxen" routine with a restoring beam of 0.4 arcsec.

techniques (Staveley-Smith et al., 1993) allows us to obtain an image with resolution of about 0.5 arcsec showing that the remnant has a shell-like morphology with brighter regions to the east and west (Figure 1; the web version of this newsletter contains full colour images of all the figures in this article). The shell evidently expanded rapidly in the first few years but slowed down to an expansion velocity of about 3000 km/s some time before 1992 (Gaensler et al., 1997). It currently has a radius of about 0.7 arcsec and is predicted to impact on the dense inner ring in 2004 with an uncertainty of about two years.

Super resolution gives more weight to the long baselines in a data set and also extrapolates into unobserved areas of the u-v plane. It is therefore inherently uncertain. While the consistency of successive 3-cm super-resolved images gave us confidence that the structure they revealed was genuine, there remained some doubt about the fidelity of these images. Since it was not feasible to extend the maximum baseline of the Compact Array, the only way to improve on existing images was to go to higher frequencies. Unfortunately the Earth has a turbulent atmosphere which perturbs the phases and amplitudes of the recorded visibilities. The phase perturbations increase linearly with frequency, and increase with baseline length in a manner which depends on the atmospheric conditions. At Narrabri, for a given angular resolution, we expect the atmospheric phase variations to be more than twice as bad at 3 mm (100 GHz) than at 12 mm (20 GHz). Also, amplitude variations will further limit the dynamic range, especially at 3 mm. Self calibration is difficult because of the small number of antennas and signal/noise limitations, so we expect that the highest resolution images with the Compact Array will be obtained at 12 mm.

This expectation has been wonderfully fulfilled. On 31 July 2003, we had a clear sky and low humidity for the entire 12 hours of an observation of SNR 1987A with the 6D array at two frequencies, 17.345 and 19.649 GHz, within the lower part of the 12-mm band. Atmospheric phases on even the longest baseline (5877 m) varied by less than or about 30 degrees between observations of a phase calibrator (0541-7332) spaced by 12 minutes, so the phase calibration was unambiguous. Observations of Mars were used to calibrate the amplitudes; despite its current closeness to Earth, it was only slightly resolved by the shortest (77 m) baseline, allowing us to bootstrap the calibration to longer baselines via the phase calibrator which was assumed to be unresolved. Within the uncertainties, the measured flux densities at the two frequencies, 25.5 mJy and 24.2 mJy respectively, are consistent with the extrapolation of the cm-wavelength spectrum. Data at the two frequencies were then combined to form a uniformly weighted image and then cleaned. The resulting image, restored with a 0.45 x 0.36 arcsec beam, is shown in Figure 2(a). The similarity of this image to the super-resolved 3-cm image shown in Figure 1(b) is remarkable, giving us great confidence in the super-resolution technique.



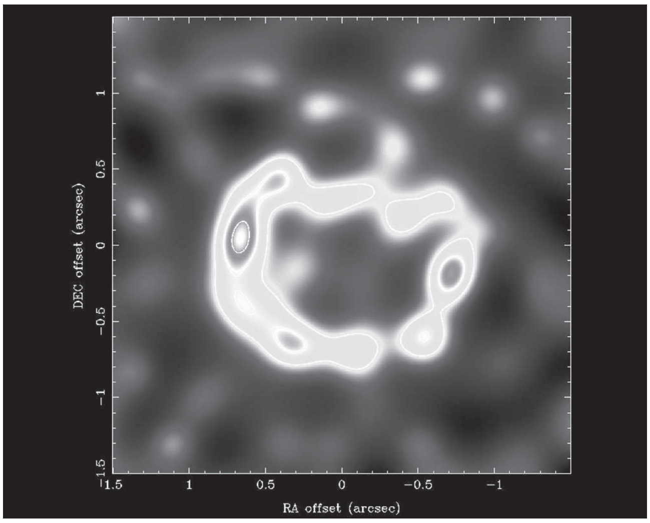


Figure 2: (a) Diffraction-limited 12-mm image of SNR 1987A obtained on 31 July, 2003 using the Compact Array in the 6D configuration. (b) Maximum entropy image restored with a 0.2-arcsec beam.

The diffraction-limited 12-mm image still does not have the resolution of HST or Chandra images of the remnant, about 0.1 arcsec. These images show “hot spots” around the inner edge of the ring, where it is believed the SN ejecta are colliding with the ring gas. There is some correlation between the hot spots in the optical and X-ray bands. Since we have now demonstrated the reliability of the super-resolution technique, the obvious next step is to try super-resolving the 12-mm image. Our first attempt at this is shown in Figure 2(b), a maximum entropy image restored with a 0.2-arcsec beam. Both the eastern and western lobes have several hotspots in this image. An interesting feature is the appearance of what may be an inner ring with a radius about half that of the main ring and three hot spots.

Comparison of the super-resolved 12-mm image with the HST and Chandra images shows no clear correlation of the radio hot spots with those at optical or X-ray wavelengths. The radio emission seems to be more correlated with the high-energy X-ray emission detected by Chandra (Park et al., 2002). Further work is needed to explore reliability of the super-resolved image, the mechanism of the radio emission and the detailed relationship of the emission in the different wavelength regimes.

These images represent the culmination of nearly a decade of effort by many people. In particular, we thank the ATNF engineers and technical staff who worked long and hard to make the 12-mm system a reality.

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Dick Manchester, Lister Staveley-Smith, Bryan Gaensler, Mike Kesteven & Tasso Tzioumis (Dick.Manchester@csiro.au)

Regular items

The ATNF SKA/LOFAR project

For the past few years, the ATNF, together with a number of other Australian groups, has been actively involved in the international Square Kilometre Array (SKA) project. The SKA is planned to be a next-generation radio telescope, with a total collecting area of about one square kilometre, operating from maybe as low as 150 MHz to about 20 GHz. The SKA will be made up of a dense core array, less than 10 km in diameter, together with array-stations with maximum baselines of thousands of kilometres, all connected by high-bandwidth optic-fibre cable. The SKA is being designed by an international consortium of eleven countries and will be built in about 10 year's time at a total cost of around A$2B.

In 2001, the ATNF led a successful proposal on behalf of the Australian astronomical community under the government's Major National Research Facilities (MNRF) Program. Our MNRF program has enabled increased Australian access to the Gemini telescopes, and has also funded SKA technology development, including the broadband upgrade of the AT Compact Array.

In 2000, the Government of Western Australia was approached by a consortium seeking to identify suitable locations for a new generation Low Frequency (10 – 240 MHz) radio telescope (LOFAR). LOFAR is in many respects a "Phase 1 SKA", and is an important testbed for many SKA technologies. LOFAR is a smaller-scale project (hundreds of kilometres maximum baseline) than the SKA, with more conventional antenna designs and lower bandwidth for its signal systems. Operations of LOFAR are targeted to start in 2006 – 2008.

Within the ATNF, the large degree of commonality between SKA, LOFAR, and MNRF has prompted the merger of these projects into a single SKA/LOFAR program. This new structure will enable greater focus to be applied to those technologies which are common to SKA and LOFAR, and will maximize the opportunities for technology development gained through LOFAR to benefit the Australian SKA effort.

LOFAR offers Australia:

- The chance to host an international, high-visibility "big science" project;

- The chance to engage Australian industry in international projects at the leading edge of information and computing technologies; and

- An increased likelihood of attracting the SKA project to a high-quality radio-quiet site, by demonstrating the success of a world-class radio synthesis array located in outback Australia.

LOFAR and SKA will both be able to detect galaxies and interstellar gas at very high redshifts. Using these telescopes we hope to explore the very beginnings and evolution of the Universe, and answer fundamental questions of cosmology. LOFAR in particular will open a new window on the Universe as it will operate in a relatively unexplored wavelength band. Key science drivers for LOFAR include: early evolution of the Universe, including detecting the epoch of reionization, high-redshift galaxies, supernova remnants, pulsars, cosmic rays, solar terrestrial and ionospheric physics, and transients, including gamma-ray bursters.

In May 2003, a joint submission between CSIRO and the Government of Western Australia was prepared and submitted to the LOFAR Consortium (ASTRON in the Netherlands, and MIT and NRL in the USA) outlining the potential for a site in inland WA to be a location for LOFAR.

WA State Government have recognized the potential benefits to WA of hosting LOFAR, and have earmarked some significant funding which they would probably be able to contribute towards infrastructure, should LOFAR be located in WA. In addition, CSIRO has recognized the technological benefits of participating in LOFAR design and construction, and significant CSIRO funding is likely to become available if ATNF and other CSIRO

Divisions participate in the design and construction of LOFAR.

In May 2003, a joint submission between CSIRO and the Government of Western Australia was prepared and submitted to the LOFAR Consortium (ASTRON in the Netherlands, and MIT and NRL in the USA) outlining the potential for a site in inland WA to be a location for LOFAR.

In September 2003, the Australian site was ranked by the LOFAR International Steering Committee to be the best site for LOFAR on scientific and technical merit. They have invited joint development of a business plan, including Australian participation, to allow planning to proceed. The understanding is that if a sufficiently attractive business plan cannot be developed, the technical selection would need to be reviewed, and an Australian siting should not be assumed until all factors, including the business plan, are evaluated. We are optimistic that satisfactory agreement can be reached, with the support of the Australian astronomical community, and that the LOFAR radio telescope can be sited in Australia, with initial operations expected in 2006 – 2008.

Given this opportunity, the National Committee for Astronomy established a Working Group in June 2003 to consider options for Australia's involvement in the LOFAR program. This group has prepared an "Options paper", outlining the choices that are available to the Australian astronomical community. Options include an upgrade path from LOFAR to the SKA involving cylindrical antennas to measure the equation of state of the Universe by detecting neutral hydrogen in high-redshift galaxies.

More information on the SKA/LOFAR Program is available on *www.atnf.csiro.au/SKA*.

2003 International SKA conference

The 2003 SKA International Workshop was held in the city of Geraldton in the Mid West coastal region of Western Australia from 27 – 31 July 2003, following the IAU General Assembly in Sydney. The SKA Workshop was followed by a two day meeting of the International SKA Steering Committee on 1 and 2 August (also in Geraldton).

The 2003 meeting attracted a record attendance, with over 135 delegates from 21 countries attending the conference. Many of the key scientific, technological and costing issues were discussed in considerable depth at the 2003 SKA Workshop.

An unusual feature of the meeting was the involvement of the local indigenous community. A local indigenous artist in Geraldton, Charmaine Green, painted the theme logo for the conference. The painting, entitled *The Emu in the Sky*, refers to the fact that the obscuring dust clouds in the Milky Way make the shape of an emu (see the 2002 ATNF annual report for a reproduction of the painting). At a certain time of year, the emu shape appears to be sitting, and the local Aborigines, the Yamaji people, know that this is the time to collect emu eggs for eating. At this same time, the constellation of Pleiades is low to the horizon. During the conference dinner, the original of *The Emu in the Sky* was auctioned, with the proceeds (over $1200) going to a local charity.

In parallel with SKA2003, the Marra Indigenous Art Collective, a collective of Aboriginal artists in Geraldton, prepared an exhibition in Geraldton of Aboriginal art on the theme of Aboriginal interpretations of the sky. A cultural highlight of the conference was a lunch attended by the Premier of Western Australia, Dr Geoff Gallop, several of the exhibition artists and the conference participants. This provided a rare opportunity for astronomers and indigenous artists to learn more about each others' craft. Many conference delegates purchased original artworks from the exhibition.

Ray Norris and Michelle Storey (Ray.Norris@csiro.au and Michelle.Storey@csiro.au)

International SKA directions

I am extremely pleased to be taking on the role of the SKA's first International Project Engineer (IPE) and am looking forward to working with the SKA Director, Richard Schilizzi, to advance this exciting world project. Here in Australia, I've been privileged to have built a great team and have been fortunate enough to have led efforts culminating in the submission of both concept and site proposals. I can't speak highly enough of the insight and dedication of the Australian group, and I have no doubt that its impact on the world scene will continue.

Internationally, the phase-2 SKA concept description documents ("whitepapers") have been reviewed and, after much discussion at the recent Geraldton meeting, detailed critiques completed by the International Engineering and Management Team (IEMT) and the International Science Advisory Committee (ISAC). Both reviews are available via the international website *(www.skatelescope.org)*. A major effort is currently being made by ISAC to update the SKA-science case, and to identify and highlight the "level-0" (imperative) science drivers. Much of the science case refinement will be undertaken at a meeting to be held in Leiden in November 2003.

Next steps in SKA engineering revolve around demonstration of the key technologies identified by the IEMT and the various concept proponents. While a level of general update material will be welcome in the phase-3 whitepapers (due 30 April 2004), the emphasis will be on outlining project plans for engineering and/or astronomy demonstrators. Preparation of these plans will be invaluable in focusing concept groups on pivotal SKA engineering demands, notwithstanding the existence of many, shorter-term, R&D imperatives. Importantly, the phase-3 whitepapers will also be central to the formulation by the international project office of realistic demonstrator timescales and evaluation criteria.

In parallel with the project-plan development, two other important international processes are underway. First, the IEMT and IPE, with the help of the newly-formed Simulations Group, are working towards common performance and costing metrics for all SKA concepts. Second, the community has recognized that no single SKA concept satisfies all the instrument's goals; serious efforts to examine the merits of hybrid, or composite, telescopes are now in progress. This convergence process will feature prominently at the January 2004 (Capetown) meetings of the International SKA Steering Committee and the IEMT.

I should also mention the considerable efforts of the international Site Evaluation and Selection Committee (SESC). The SESC, and its engineering working group dealing with site characterization (including RFI measurements), is still progressing towards a 2005-site choice. Part of the IPE's role is to oversee the relevant engineering activities and I am looking forward to working with many colleagues around the world in this role.

The next full international SKA meeting will be held in July 2004, in Penticton. With so much happening, and the possibility of a working retreat prior to the main meeting, I expect the growing scale and pace of the SKA project to result in an intense and productive Canadian gathering.

Peter Hall
(Peter.Hall@csiro.au)

Compact Array and Mopra report

Operations

We are now in the final parts of the 3-mm observing season. While this winter has been more typical in terms of rainfall (unlike the drought of 2002), the number of “swaps” of millimetre/centimetre projects that were initiated remained low, and the fraction of good weather for the 3-mm observing was high. This year however there were a small number of 3-mm and 12-mm observing runs that were effectively ruined by poor weather. This is in contrast to 2002 when there were essentially none.

With major upgrades to the antenna receivers, local oscillator systems and control computers in April, May and June, it is very pleasing that the downtime fraction improved this term. 40% of the downtime was due to wind stow conditions (Figure 1). There were few teething problems of any significance in bringing the new systems into routine use, a major tribute to all those involved in developing and commissioning these systems.

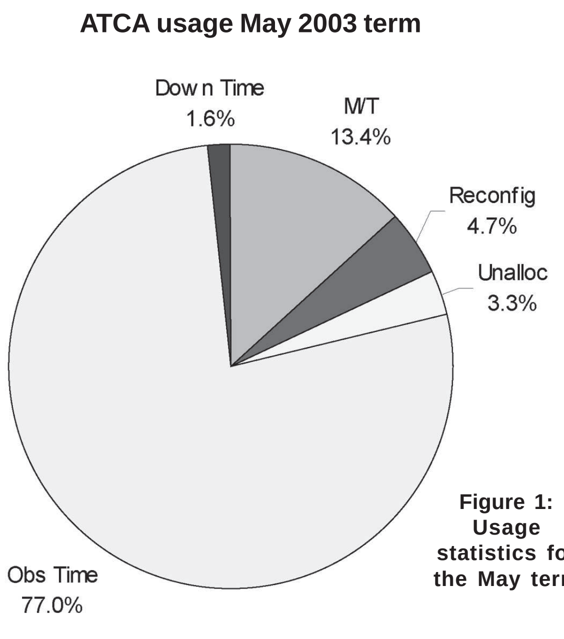

Figure 1: Usage statistics for the May term

The new antenna control computers are now paying back the large investment put into their development. In addition to significantly improved reliability, the enhanced flexibility of monitoring aspects of the system (e.g. antenna drives) is allowing us to better tune the antennas. The new control computers are also allowing observing modes that would have been difficult or impossible with the old computers. For example, the Compact Array is currently undertaking an all-sky survey which uses a fast scanning mode made possible with the new system.

Work is proceeding on porting all the observing system to a LINUX environment, with the “first fringes” achieved with the new software on 10 September.

The flow of science using the new 12-mm systems increased significantly during the last few months, with the first polarimetric images and first mosaics being produced (see the separate article on SN1987A at 12 mm). The 12-mm system is proving to be excellent overall.

Radio frequency interference at the Compact Array

At different times over the last few months, the observatory has had a number of instances of significant radio frequency interference (RFI) affecting our HI observers. Two sources of interference were tracked to equipment outside the ATNF’s direct control. However in both cases, the equipment owners acted promptly when they became aware of our difficulty. The third significant source of interference was tracked to our masers that were undergoing temporary major maintenance outside the screened room. This, too, has been resolved. Although these have been resolved, there are a number of lower-level RFI signals. Despite the greater robustness of an interferometer to RFI, we need to remain vigilant. We are currently buying some test gear to help us locate RFI in a more straightforward manner.

Staff

Ollie Dowd has recently left us. For the last 11 years, Ollie has been one of our maintenance fitters devoted to the health of the mechanical components of the antennas. Ollie leaves us to take on a position in Victoria. Le-Cuong (“Lee”) Nguyen has also recently left Narrabri. Lee is a student from the University of Technology who was with us for six months as part of his industrial experience. Lee made significant steps in implementing the new telescope monitoring software, which will soon be introduced to complement the new antenna control computers. With Lee’s departure, we welcome Stjepan Koljatic (“Steve”). Steve is an electronics student from Latrobe University, who is currently completing his industrial experience component of his course.

Outreach

The last few months have seen a variety of outreach efforts being undertaken. At the professional end of the spectrum, we hosted three separate tours by large groups of astronomers who were mainly in Australia to attend the IAU. In total, about 70 professional astronomers (other than our usual observers) visited the Observatory in the weeks around the General Assembly.

On 6 October we hosted a low key Open Day for the general public (Figure 2). The main attractions on offer were the Visitors Centre, an antenna vertex room and the Control Room. A total of 250 – 300 people attended, with 197 people visiting the antenna vertex rooms. The local Apex Club put on a sausage sizzle – but unfortunately drizzly weather forced the cancellation of a jumping castle.

Part of the preparation for the Open Day included the production of a new brochure on the Compact Array, as well as a new “Welcome” poster panel for the Visitors Centre. Work in progress includes major new landscaping work around the Visitors Centre, and the repair of the “People’s Telescope” (a simple solar radio telescope).

Mopra

The Mopra millimetre observing season has recently finished, with the final observations on 5 October. The 3-mm receiver system performed well over the winter, with only a few problems associated with ices in the 4-K stage of the cryogenics. Surface adjustments have considerably improved the surface accuracy of the antenna (from 260 μm to about 160 μm rms). Coupled with improvements to the “coma lobe” problem in May, the aperture efficiency of the telescope is also significantly improved. With the completion of the main observing season, a new antenna control computer has been installed at Mopra, and is in the process of integration with the observing system. Despite these positive steps, Mopra, remains a difficult observing environment. It still requires significant development to achieve its full potential as a 3-mm spectroscopic instrument. With the closure of SEST, and the concentration of APEX at shorter wavelengths, Mopra is the only telescope of its class in the southern hemisphere.

In previous years, Mopra has played a significant role in VLBI observations associated with the VSOP spacecraft. Unfortunately this spacecraft had a major failure in February. Spacecraft operation was re-established in September, but failed again only a matter of weeks later. The future of VSOP observing remains unclear.

Bob Sault
Officer-in-Charge, Narrabri
(Bob.Sault@csiro.au)

Figure 2: A crowded Control Room during the Open Day

Parkes Observatory report

Staff

Rick Twardy has left CSIRO after 17 years' sterling service running the Visitors Centre (VC). In respect of his future Rick says he now knows how Schrodinger's cat must have felt. We all wish him every success for the future, whichever path he chooses!

Another "John" has joined the Parkes staff, bringing the total to four. John Smith started as Manager of the Parkes VC and Coordinator of the Parkes and Narrabri VCs at the end of August. John was most recently in CSIRO Corporate Communications in Canberra, on a 12-month secondment from Livestock Industries in Brisbane.

NASA tracking contract

Contract tracking for NASA began in mid-September with commissioning tests, and has now become a daily occurrence. The new X-band (8.4 GHz) receiver commissioned for this project, teamed with the successful surface upgrade of the telescope (Figure 1; also see June Newsletter) has delivered almost a four-fold increase in sensitivity at this frequency. The receiver is performing much better than minimum specifications, with a zenith Tsys of 25 K. Congratulations go to Graham Moorey, Russell Bolton and the Marsfield receiver team for another world-class piece of hardware.

The only significant teething problem with the receiver was a tendency for condensation to form on the input dewar window but perseverance, from Brett Dawson and Dave Catlin in particular, has solved this problem and the system is now working perfectly.

John Sarkissian and Stacy Mader have taken on the responsibility of telescope operators for the period of the NASA tracking. Both recently visited Tidbinbilla to study operations there, and several Tidbinbilla staff have likewise visited Parkes. All have found this contact stimulating and rewarding. Lots of accompanying pictures can be found in the status reports at *www.parkes.atnf.csiro.au/ documentation/mars*.

Receivers

In addition to the delivery of the new X-band (8.4 GHz) receiver, two other important changes to our receiver fleet are about to occur.

The 21-cm Multibeam receiver will be removed from the focus cabin in the week of 20th October for refurbishment, and replaced by the new 10/50-cm pulsar receiver. This receiver has run essentially non-stop since its installation in 1997, a testament to the quality of its design and construction. It has however developed signs of aging in the last 18 months, with one completely dead channel (10A), several with high Tsys or unstable gains and, just recently, possible intermittent faults with the all-important central beam. All faulty amplifiers will be replaced during the refurbishment which is expected to take until April 2004.

The new 10/50-cm dual-frequency receiver is designed primarily for pulsar observing but with the increased sensitivity at 50 cm there is considerable interest in observing redshifted HI. One looming problem with the 50-cm band is the rollout of digital TV services throughout NSW, which started in earnest in July this year. Already, three new powerful transmitters have begun broadcasting from Mt Canobolas near the edge of our observing band. Active consideration is being given to shifting the receiver filters to a higher band (690 – 750 MHz approx) to avoid the interference.

Operations

More moderate wind conditions have fortunately continued to prevail since the extremely windy period around January this year. Recent lost-time statistics are:

Observing time lost to faults (year to date) - 1.5%
Observing time lost to wind (year to date) - 3.9%

Observing time lost to wind (since 1 May) - 2.2%

CPSR2, the baseband recorder with a data rate of 1 Gigabit/second, continues to operate well, with operations now simplified to the point where use by

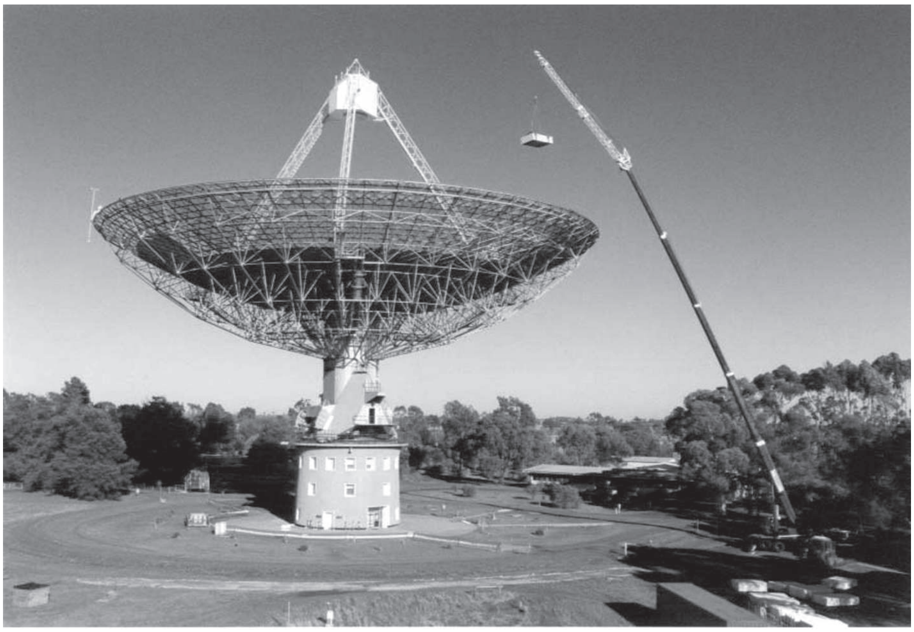

Figure 1: The final stages of the Parkes dish resurfacing in preparation for the NASA tracking.

non-experts is now straightforward. The wideband correlator is also working well generally, though with a number of niggling bugs still requiring attention.

Computing

Further to the report in the last Newsletter, upgraded cabling has now been installed across the entire site (including the Quarters' bedrooms, for true E-mail addicts) and we have begun moving computers across to it. This process has been delayed by concerns over the cable test results, and the likelihood that substantial retesting will be required. However the cabling is already yielding dividends by allowing high-speed connections to be established between various points of the site very easily, compared to the contortions often required in the past. Once again credit goes to Brett Preisig for keeping this project moving and to Tim Ruckley and Shaun Amy for invaluable support.

Three new Sun Blade 150s have been installed in the control room, replacing older Ultra 1 or 2 machines. A second Sunfire V120 will soon be installed as the main online file server.

An Ultra 10 has been installed in the Quarters conference room, giving guests a Unix option.

Site changes

The main administration building (the Opera house) has been extended to provide an additional office, more library shelving, and a greatly expanded workspace for visitors. It is planned to provide additional workstations (both PCs and Unix) in this area.

Building work at the Quarters continues, with the new ladies' bathroom nearing "first flush". Work will then begin in earnest on the new kitchen.

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

The Parkes Mars tracks

Over the last decade, NASA has taken advantage of the relative proximity of Mars to Earth during the opposition years, to embark on an ambitious program of exploration of the red planet. This year is no exception.

During the peak activity period later this year and early next year, there will be a total of six spacecraft at Mars. In addition to these Mars spacecraft, there will be others spread out throughout the solar system, all needing to be tracked also. The orbital geometry of these various spacecraft means that during this peak activity period, most of these spacecraft will be clustered close to the same celestial longitude (right ascension) of Mars. Tracking all these spacecraft, poses a scheduling dilemma for the mission planners. Normally, the spacecraft are more-or-less distributed uniformly throughout the solar system, so that the three tracking stations of NASA's Deep Space Network (DSN), can easily handle the workload. The stations are located approximately 120 degrees apart around the globe, so as the Earth rotates the spacecraft progressively come into view of each station. In this way, a continuous coverage is maintained.

This year however, is an exception. Because there are so many spacecraft clustered about Mars, scheduling adequate coverage for the various missions has become a major concern. A sophisticated scheduling system with a team of hundreds of negotiators around the world ensures that each mission´s priorities are met. In order to augment the capabilities of the Canberra Station at Tidbinbilla, and to provide greater flexibility for the schedulers, Parkes has been contracted to act as an extra receiving antenna. Within the DSN, Parkes is identified as DSS-49 (Deep Space Station 49).

The peak activity period from early November to mid-February is referred to as the Asset Contingency Period (ACP). During this period, the two NASA spacecraft, Mars Global Surveyor and Mars Odyssey 2001, which are currently in orbit about Mars, will be joined by four more spacecraft. The NASA Mars Exploration Rovers 1 and 2 (MER-1 and MER-2) are currently on their way to Mars and are scheduled to land on the surface of Mars on 4 and 25 January respectively. They will roam about the surface, sampling the soil for evidence of sub-surface water and will return thousands of images of the Martian terrain.

The European Mars Express (MEX) spacecraft (launched in June by a Russian Proton rocket) will arrive in Mars orbit late in December. On 20 December it will deploy a probe that will land on the surface on Christmas Day and will search for evidence of past or present life. This lander is a British craft called "Beagle 2" which is named after Darwin's ship of exploration.

Finally, in early January the Japanese "Nozomi" spacecraft will arrive at Mars and go into orbit. It is designed to study the upper atmosphere of Mars.

Since Parkes only has receive capability, it will only track those spacecraft that are scheduled to be transmitting data only, that is, when two-way communication is not required.

Parkes preparations

Preparations for these tracks have been underway at Parkes and Epping for the last two years. The spacecraft at Mars will be transmitting at frequencies close to 8.4 GHz. In order to receive these signals, a new low-noise, X-band receiver has been built by the receiver group at Epping. The receiver has a 50-MHz-wide bandpass centred on 8.4 GHz. It was installed in August 2003, and tests have shown that it has a Tsys of about 25 K, significantly better than the contractual specifications.

In order to further enhance the efficiency of the telescope at these frequencies, in March 2003, the dish surface was upgraded. This resurfacing extended the perforated aluminium panels out to 55 metres diameter. Tests have since shown that the surface accuracy of the dish is now 0.8-mm rms for the inner 55 metres. The combined receiver and dish surface upgrade have now contributed to making the telescope some 6 dB more sentitive at X-band - a great boon for radio astronomers.

Beginning on 8 September, a week long period of Installation, Implementation and Testing (I, I&T) was undertaken following the installation of the receiver. Five five-hour tracks were performed to verify that the receiver worked according to specifications and that the various NASA/JPL equipment were installed and functioning correctly.

Next came three weeks of the Mission Support Training Activities (MSTA's). This period saw the Operations Protocol of the Parkes Mars tracks developed. Four five-hour tracks were performed weekly. A tracking manual detailing the protocol was prepared. A secure Predicts, Schedules and Sequence-Of-Event's (PSS) file transfer protocol was implemented and tested. The new Mars tracking software for the telescope drive system was tested and debugged. The Parkes Mars tracking operators were trained and new, more efficient procedures were suggested and implemented. John Sarkissian and Stacy Mader will be the two principal operators during the Parkes Mars tracks. John Reynolds, Lewis Ball and Gina Spratt will be the backup operators.

From 6 October, the Proficiency Tracking period commenced. This period was intended to further train the operators at both Parkes and Tidbinbilla and to iron out and correct any remaining problems with the tracking protocol and equipment. Operations switched to seven days a week, with tracks lasting between six to seven hours each.

The contract tracking period (the ACP) commences on 3 November with routine operations support beginning. At that time, Parkes will be used for spacecraft tracking on a daily basis during the view period of the prime JPL missions approaching Mars or in Mars orbit, that is, essentially from Mars rise to Mars set. The scheduled support time will include a standard pre-track setup time of about one hour and a post-track teardown time lasting about 15 minutes.

Parkes will be used until the available tracking time during the Mars view period becomes too short to provide substantial support or the overload condition no longer requires support (whichever comes first). Support from Parkes should not be required after approximately 1 March, 2004.

In order to aid observers in the planning of their observations, the following plot (Figure 1) has been produced to indicate the daily LST range for which the telescope will be available for general astronomy during the ACP.

Further information and pictures of the work in progress can be found at the following web site: *www.parkes.atnf.cisro.au/documentation/mars/*

John Sarkissian
(John.Sarkissian@csiro.au)

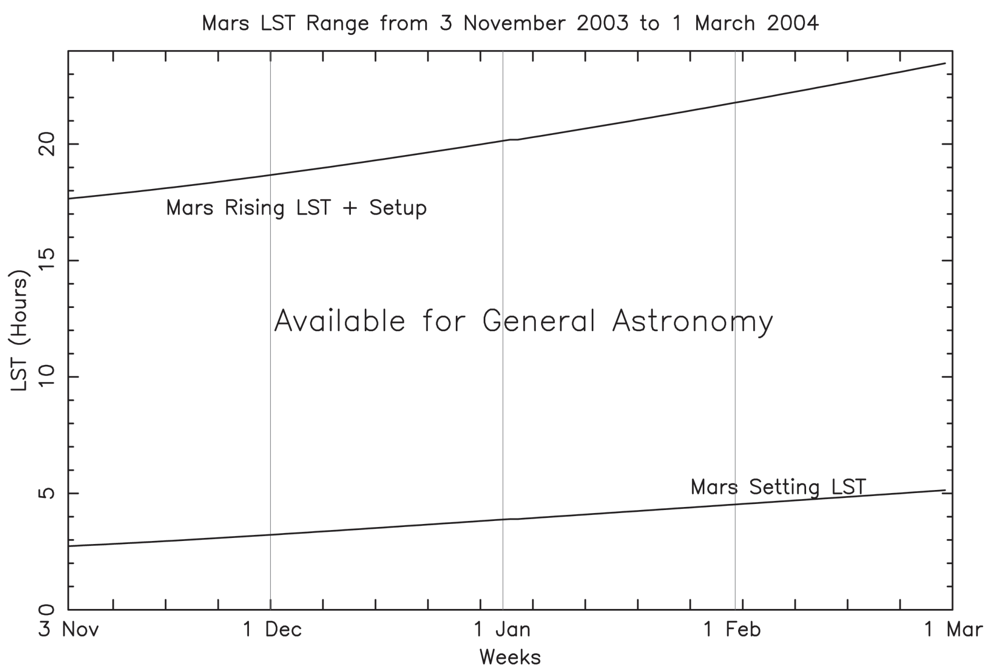

Figure 1: The daily LST range for which the telescope will be available for general astronomy during the ACP.

Time assignment information

Changes to observing terms

Applications for telescope time on ATNF facilities are considered by the Time Assignment Committee (TAC). This committee currently has five voting members and meets three times a year. Approximately 110 applications are considered at each TAC meeting.

At the July 2003 meeting of the ATNF Steering Committee, the operations of the Time Assignment Committee were discussed and a decision was made to implement a change from three four-month observing terms per year, to two six-month observing semesters. This change will allow for more efficient scheduling, in particular at the Compact Array and will reduce the work load on the Time Assignment Committee. The Steering Committee also decided to increase the size of the TAC, from five to six voting members.

The semester dates and deadlines for telescope applications in 2004 will be finalized in November 2003, following discussions with the ATNF User Committee (ATUC) and the TAC. Full information will be made available on the ATNF Observers web pages.

Compact Array and Mopra

In 2004 JANT we will be offering the array configurations 6B, 1.5A, 750A and EW367. The term will also start with 6A. Observing will be possible with the standard 20, 13, 6, 3-cm and 12-mm systems on all six antennas. In the 12-mm window, it is possible to select two different observing frequencies. However, the signals at both frequencies must pass through a common filter in the down conversion stage. This means that the two frequencies must both lie within only one of the following two ranges:

- 16039.5 – 20999.5 MHz (“X-band”: filter)
- 21000.5 – 24999.5 MHz (“C-band” filter)

Additionally, the frequencies must not differ by more than 2.8 GHz for the X-band filter, and 2.3 GHz for the C-band filter.

Summer weather means 12-mm observing will be difficult during much of the term.

Although three antennas will be available with 3-mm systems, the normal weather during almost all the term will make this unattractive. The frequency range for the 3-mm systems is limited to two sub-bands of 84.9 – 87.3 GHz and 88.5 – 91.3 GHz. Observing in the 3-mm band requires an observer present who has had previous experience with the ATCA 3-mm systems.

Requests for the Mopra radio telescope may be considered at 12-mm and centimetre wavelengths if it can be demonstrated that Mopra offers a significant advantage over other facilities and where a substantial time is required.

Overseas remote observing at the Compact Array

Remote observing at the Compact Array has been available to observers in Australia for some years. This facility is now also available to overseas observers, subject to some conditions. In general, overseas remote observing will be allocated at the discretion of the Narrabri Officer-in-Charge. A condition for accepting such a request is that the observer must have served as Duty Astronomer for at least one week within the last year, or be scheduled as Duty Astronomer in the near future.

Additionally, remote observers will be required to have a workstation and link with sufficient speed and responsiveness to adequately run the observing software, and be able to receive or make phone calls between Narrabri and their observing room.

For full information on remote observing conditions, please refer to the web document *www.narrabri.atnf.csiro.au/observing/remote_conditions.html*

Jessica Chapman, Bob Sault
(Jessica.Chapman@csiro.au)

ATNF publications list

Publication lists for papers which include ATNF data are available on the Web at: *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 2003 newsletter. *Papers which include one or more ATNF staff are indicated by an asterisk.*

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Contact information

CSIRO Australia Telescope National Facility

PO Box 76
Epping NSW 1710
Australia
(Cnr Vimiera & Pembroke Roads
Marsfield NSW 2122)

Ph: +61 2 9372 4100
Fx: +61 2 9372 4310
atnf@atnf.csiro.au
www.atnf.csiro.au
ftp.atnf.csiro.au

Parkes Observatory

PO Box 276
Parkes NSW 2870
Australia

Ph: +61 2 6861 1700
Fx: +61 2 6861 1730
parkes@atnf.csiro.au
www.parkes.atnf.csiro.au

Paul Wild Observatory, Narrabri

Locked Bag 194
Narrabri NSW 2390
Australia

Ph: +61 2 6790 4000
Fx: +61 2 6790 4090
narrabri@atnf.csiro.au
www.narrabri.atnf.csiro.au

Mopra Observatory, Coonabarabran

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