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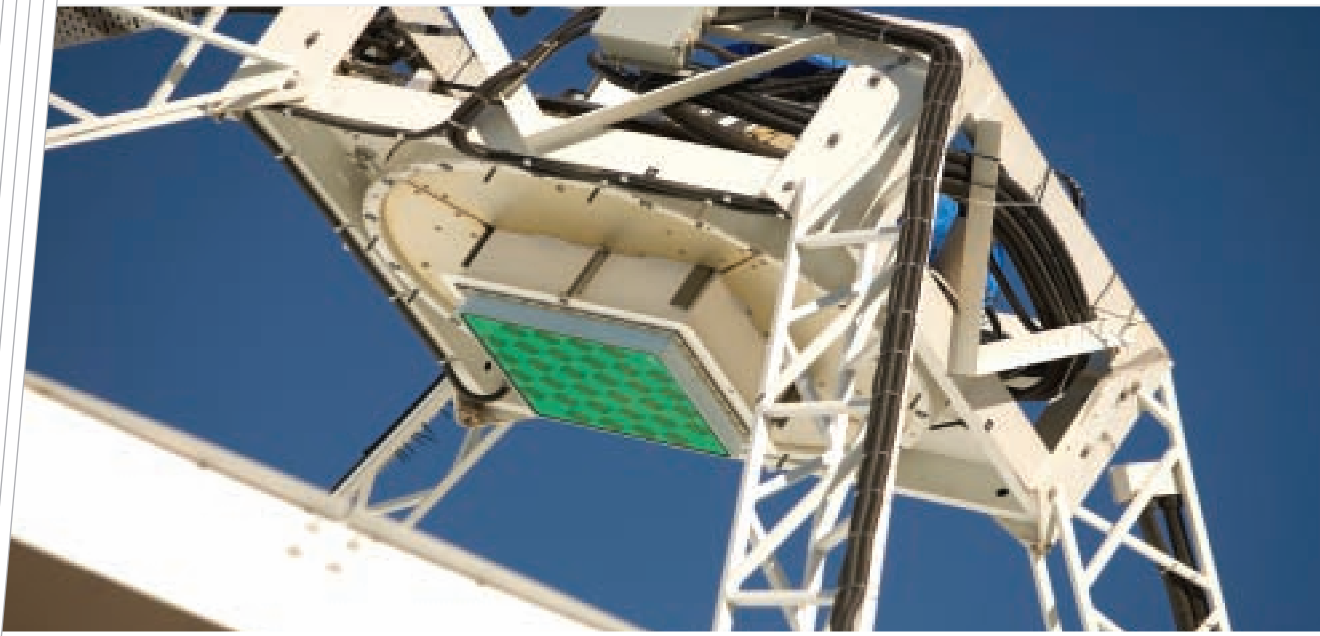

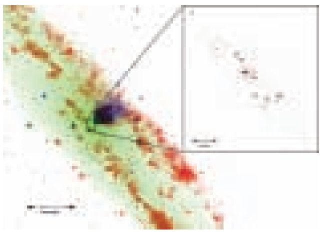

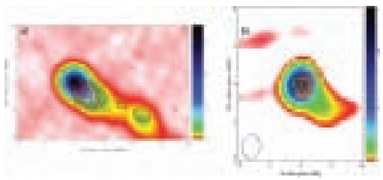

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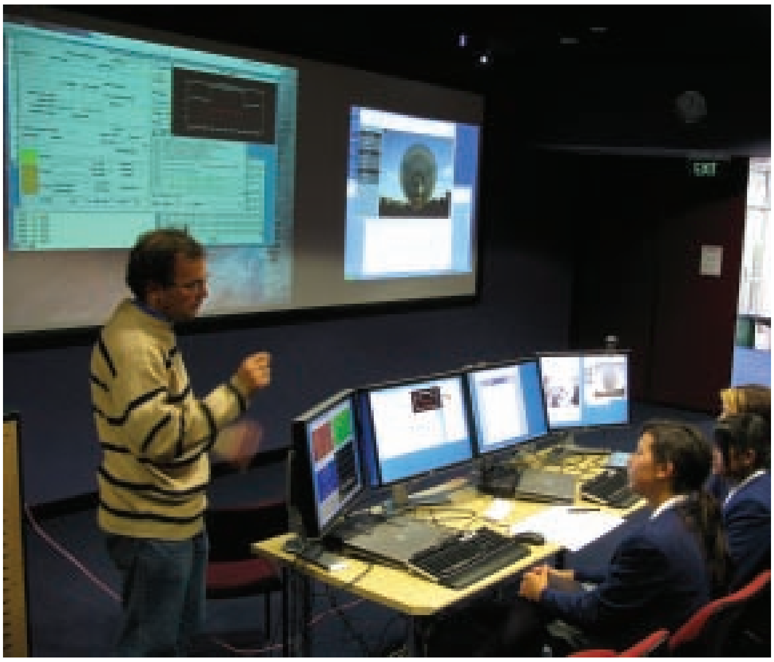


Students from Caroline Chisholm College observing for the PULSE@Parkes project.

Photos: Robert Hollow, CSIRO

ATNF outreach

Rob Hollow (ATNF)

PULSE@Parkes project

The PULsar Student Exploration online at Parkes (PULSE@Parkes) project is now up and running successfully on a regular basis. We host one high school per month at Marsfield for student observations. Schools receive a pre-observing visit by a project staff member to learn about radio astronomy, pulsars and what an observation session involves. A successful demonstration session involving 15 students from three Perth schools was held at the SPICE Centre at the University of Western Australia in March 2008.

Talks about the program were presented at the American Astronomical Society/ Astronomical Society of the Pacific Joint Meeting in St Louis in the USA in June 2008, as well as the Astronomical Society of Australia annual meeting in Perth, the national science teachers' conference, CONASTA, in Queensland in July 2008 and the NSW Science Teachers' Conference in late November 2008.

ATNF's Education Officer, Rob Hollow visited the University of Texas, Brownsville in June as part of the project collaboration. He spent a week at their Summer School for High School Students presenting several sessions and learning more about the programs run there including the Arecibo Remote Control Centre.

For more information visit the project webpage: *http://outreach.atnf.csiro.au/education/pulseatparkes/*

Cover page images

Photo: David McClenaghan, CSIRO (See page 9)

Photo: Carole Jackson, CSIRO (See page 9)

Image: Emil Lenc, CSIRO and Steven Tingay, Curtin University of Technology (See page 23)

Image: Richard Dodson, University of Western Australia (See page 26)

Contents

Editorial

Regular readers of the ATNF News will not have failed to notice that this is the first issue in our new format, with the adoption of a standardised CSIRO format for the design and layout. This year also marks a change from three to two issues a year, nominally in April and October.

This issue contains an obituary for Dr Paul Wild, who passed away in May 2008. Paul Wild was instrumental in the design and establishment of the Culgoora Solar Radio Observatory in the 1960's, served as Chief of the Division of Radiophysics in the 1970's, and was Chairman of CSIRO from 1978 to 1985. The Culgoora Observatory is now home to the Australia Telescope Compact Array (ATCA), and elsewhere in this issue Helen Sim looks back over 20 years of the ATCA and identifies a number of its strengths and successes. One of the strengths is the solid grounding students receive in observing with the ATCA, and Phil Edwards reports on the 8th Synthesis Imaging School at the ATCA .

A report on the Parkes Pulsar Timing Array, and articles describing studies of the Magellanic Stream, the starburst galaxy NGC 4945, and polarisation observations with the Long Baseline Array, illustrate the breadth of science being undertaken with ATNF facilities. The recent changes to the structure for managing telescope operations are outlined, and ongoing planning for future operations, incorporating ASKAP, are presented.

This issue is the last with Mary Mulcahy at the helm as Mary will move on to a new position in another division of CSIRO in the new year. We thank Mary for her enthusiasm and attention to detail in her role as ATNF Communications Manager.

Mary Mulcahy and Jo Houldsworth

The ATNF Newsletter Production Team
(newsletter@atnf.csiro.au)

NEWS

From the Director

Brian Boyle

CSIRO ATNF Director

As I write this I am struck by a tremendous sense of what has been achieved in Australian radio astronomy during 2008 by ATNF and CSIRO more broadly, together with our many partners.

The list of specific milestones that come to mind includes the following:

- During the first half of the year there was a specific focus on proactively engaging with the ATNF user community to discuss the plans for changes to ATNF operations. The need for change is undeniable given the commitment to operating a new world-class observatory, the Australian Square Kilometre Array Pathfinder (ASKAP), in a few years time in an environment where costs are growing faster than recurrent funding. The engagement with the community involved significant effort from a number of senior ATNF staff, including roadshows to most major cities in Australia to engage with our user base to discuss planned operational changes, the development of a set of Science Priorities for the ATNF telescopes for the 2010–2015 period, the development of the User Policy for ASKAP, and the call for Expressions of Interest for the major Survey Science Projects for ASKAP. Together these efforts have been very positive in securing a strong and healthy engagement between ATNF and the astronomy community. The response to the call for Expressions of Interest in ASKAP survey science has provided an outstanding demonstration of the vibrancy of the international astronomy community, and of the potential for ASKAP to deliver groundbreaking science. Thirty eight expressions of interest have been received, from a total of 608 investigators (354 independent) based in 23 countries. Over the coming weeks these will be assessed, and then invitations will be extended to groups to develop full proposals. Given that it is likely that there will be just five or so ASKAP survey science projects over the first five years of operation, this degree of interest at this early stage augurs well for great science.
- From 1 July 2008 the organisation of ATNF Operations changed from a strong observatory alignment to a "Science Operations" and "Engineering Operations" structure that extends across all ATNF observatories, and which will include ASKAP once scientific operations begin in 2012. The new structure is already resulting in a positive sharing of knowledge across the wide range of ATNF activities. The transition from leadership by our excellent Officers in Charge, John Reynolds (Parkes) and Phil Edwards (Narrabri) to the Head of Engineering Operations, Brett Dawson, and of Science Operations, Phil Edwards, has been effected seamlessly.
- In August the ASKAP team achieved first light with the chequerboard Phased Array Feed designed by John O'Sullivan on the newly-commissioned 12-m testbed antenna at Parkes. The results were and continue to be very encouraging, with a remarkable degree of agreement between the measured and predicted performance which underlines the team's deep understanding of the physics of these systems. While there are still many challenges to be solved with these systems the results achieved to date are very promising and indicate the retirement of some of the greatest technical risk involved in the ASKAP project.
- The signing of the ASKAP antenna contract with CETC54 was another major milestone for the year. CETC54 will deliver thirty six 12-m antennas, including an innovative third rotation axis judged necessary to achieve the very high dynamic range target for ASKAP, for under A$10M meeting a cost target considered by many to be a major commercial challenge for the project, and even for the SKA itself.
- More broadly, the Australian SKA Industry Cluster has played a key role in furthering industry participation in the ASKAP project. A number of strategic partnerships have been forged, and the release of the Industry Opportunities Register in October was a significant highlight.
- The approval on 3 December in the Australian Federal Parliament of the expediency motion for the construction of ASKAP following the completion of its consideration by the Parliamentary Standing Committee for Public Works (PWC) amounts to the "green light" for the start of construction. The PWC submission involved a great deal of effort across CSIRO, with support from the Commowealth and WA State governments. It stands as a testament to the ability of CSIRO to undertake large, unique, capital intensive scientific developments in Australia. Moreover, it serves as an appropriate conclusion to a highly successful year for "Team Australia" which began with the highly successful international SKA Forum in Perth.

- The continued successful development and testing of the Compact Array Broadband Backend (CABB) correlator during 2008 has been very pleasing. Recent months have been regularly punctuated by reports of the progressive solution of technical challenges, and of successful tests of an increasingly capable system. Once operational, CABB will revolutionise the scientific capability of the Compact Array and maintain its competitiveness in the Expanded Very Large Array (EVLA) and the Atacama Large Millimeter Array Project (ALMA) era.

The fact that these milestones, have been achieved while continuing to operate three very complex scientific observatories 24 hours a day, 7 days a week, facilitating the remarkable scientific discoveries outlined in this newsletter and detailed elsewhere, is a tribute to the efforts of all the staff involved within ATNF and elsewhere in CSIRO. The scientific productivity of the ATNF's telescopes remains outstanding, and the articles in this Newsletter give a taste of the quality of the science that continues to be delivered through the expertise of the users of the ATNF.

Finally I'd like to welcome all the new appointees to the ATNF, some of whom are featured in this newsletter. The ATNF has an outstanding pool of talent in its staff and its greatest strength derives from the knowledge and dedication of those people, be they engineers, scientists, technicians or experts in some other area that is integral to achieving CSIRO's goals in the field of radio astronomy.

Best wishes to everyone at the end of 2008, and here's to a happy and prosperous 2009.

Dr John Paul Wild AC CBE MA ScD (Cantab.) FRS FTSE FAA 17 May 1923 – 10 May 2008

Geoff Garrett, CSIRO Chief Executive

CSIRO deeply regrets the passing of Dr John Paul Wild, distinguished scientist and former Chairman of CSIRO. Dr Wild died on Saturday, 10 May 2008.

Dr Wild was one of Australia's most respected and inspirational scientist and engineers.

Dr Wild was best known for his contributions to Solar Science. He was part of the team that built and operated the original solar radiospectrographs and later the Radioheliograph at Culgoora in NSW. The Radioheliograph was a ground breaking instrument producing real time images of solar activity across a range of altitudes from the sun's surface. In the late 1960's and early '70's the Culgoora group led the world in solar research attracting prominent solar physicists from around the world.

Dr Wild successfully applied his considerable initiative and expertise to the development of ground breaking technology for industry and the community. As Chief of the CSIRO Division of Radiophysics from 1971 until 1978 he led the team that developed the Interscan aircraft landing system that was adopted in 1978 as the international standard.

Colleagues appreciated his generosity in sharing ideas. He was extremely approachable and had the magical ability to reduce the most complex of concepts to simple terms understood by all. His colleagues appreciated the fact that when these concepts were realised in practice he never failed to acknowledge the role they played in developing them.

Dr John Paul Wild

Photo: CSIRO

As Chairman of CSIRO from 1978 to 1985, Dr Wild was a national science leader. He led the Organisation through the restructure designed in 1978 to modernise the Organisation and bring it closer to the industries and community which it serves. He recognised that CSIRO needed to adapt and provide scientific and technological leadership in a changing world. And, as he wrote in 1984 "Yet, whatever the changes, one characteristic must remain inviolate: a high standard of excellence and originality. Without excellence and originality, research achieves nothing." During this period he was instrumental in securing funding for major national research facilities including the oceanographic research vessel, the Australian Animal Health Laboratory and the Australia Telescope, and he established a new Division of Information Technology.

He has left a rich inheritance which will continue to bring enormous benefits to Australia.

On behalf of his colleagues and friends at CSIRO, I would like to extend our condolences and best wishes to his family and friends.

Parkes achieves world-beating pulsar timing precision

Dick Manchester (ATNF)

The Parkes radio telescope has a well-founded reputation for pulsar astronomy, with about two-thirds of the approximately1800 known pulsars having been discovered there. While discovering pulsars is important, the most significant science comes from the follow-up studies, especially pulse timing observations. Now Parkes can lay claim to achieving world-beating pulsar timing precision using the Pulsar Digital Filterbank (PDFB) systems developed at ATNF.

Pulsars are remarkable objects, tiny spinning neutron stars formed in supernova explosions at the death of massive stars. They have super-strong magnetic fields and the combination of this with very rapid rotation – the fastest known pulsar spins 716 times every second – means that pulsars are highly efficient dynamos, generating enormous electric fields in the "magnetosphere" surrounding the neutron star. These electric fields accelerate charged particles to ultra-relativistic energies resulting in the emission of powerful beams of radiation. These beams sweep across the sky as the star spins, generating a periodic train of pulses for any observer in their path. Because of the huge moment of inertia and small radius of a neutron star, the pulse periodicity is extraordinarily stable, making pulsars marvellous celestial clocks.

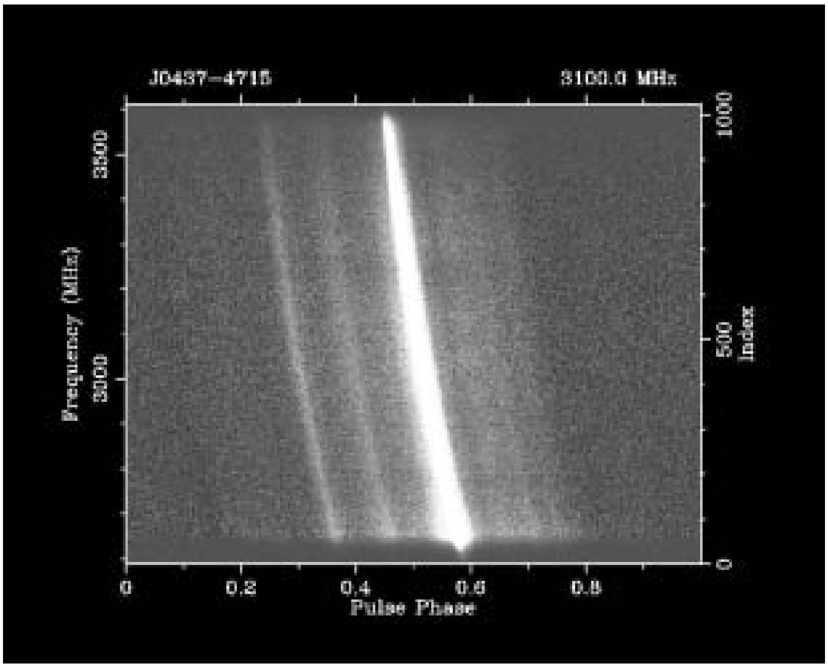


Figure 1: Greyscale plot of intensity of PSR J0437-4715 as a function of pulse phase and frequency. The one-hour observation was made on 6 September 2008 using the 10-cm receiver with a total bandwidth of 1024 MHz and PDFB2 in folding mode. The plot is of the raw spectral data and has been clipped at 20% of the peak to better show the low-level structure.

Timing of pulsars has many applications ranging from studies of neutron-star interiors to testing of theories of gravitation. Pulsar timing can also be used to establish a so-called "pulsar time" and to check for irregularities in the international timescales based on atomic clocks. Although pulsar timing observations were made over many years at Parkes using the analogue filterbank systems used for pulsar searches, precision pulsar timing really began in 1993 with the Fast Pulsar Timing Machine, a collaborative effort between Caltech and ATNF. Since then, several generations of baseband recording systems giving increasing timing precision have been developed in collaboration with Swinburne University of Technology and used, especially for pulsar astrometry and the study of binary pulsars. In 2003, the Parkes Pulsar Timing Array (PPTA) project was established with the principal goal of making a direct detection of gravitational waves using pulsar timing. To have a chance of reaching this ambitious goal, regular observations of at least twenty millisecond pulsars over 5 – 10 years with unprecedented timing precision are required.

In order to reduce the perturbing effects of propagation through the interstellar medium, observations at relatively high radio frequencies are best for precision pulsar timing. But pulsars, especially millisecond pulsars, are relatively weak and steep-spectrum radio sources, so wide bandwidths are required to give the necessary sensitivity and radio frequencies of a few GHz are optimal. The 10/50-cm receiver was designed with these ideas in mind, with the 10-cm system having a bandwidth of 1 GHz between 2.6 and 3.6 GHz. Such bandwidths place severe demands on the signal processing system.

The PDFB system was designed to meet this challenge. It has 8-bit digitisation of either two or four input signals and a maximum bandwidth of 1024 MHz. A polyphase filterbank is used to split each input signal into a maximum of 2048 frequency channels. Channel outputs are correlated to give four polarisation products per channel. These are then synchronously folded at the apparent pulsar period and integrated in a pulsar binning memory with a maximum of 2048 bins per period. These maximum specifications can be reached for pulsars with periods of four milliseconds or more. The system is based on the signal processor board developed for the Compact Array Broadband Backend (CABB) system which contains 10 high-performance Field Programmable Gate Array (FPGA) chips and a large amount of memory.

The PDFBs have several modes of operation. Normally they are used with two inputs to produce full-polarisation pulse profiles in each channel across the band. Figure 1 shows a typical observation of the strong southern millisecond pulsar, PSR J0437-4715, illustrating the high time and frequency resolution of the observations. They can also operate in "search" mode where data from each frequency channel is integrated for a time, typically 100 microseconds, and then dumped to disk, and in spectral-line mode which is similar except that integration times are typically longer. For fold-mode and search-mode data, files are written in PSRFITS format, whereas spectral-mode files use RPFITS format. The PDFB system can also operate as a front-end for the next-generation baseband system, ATNF Parkes Swinburne Recorder (APSR), currently being developed in conjunction with Swinburne University of Technology. A system for real-time mitigation of radio frequency interference (RFI) using adaptive filtering is also provided.

To determine pulse times-of-arrival (TOAs), the calibrated total intensity pulse profiles are correlated with a standard profile template giving the phase of a reference point on the template relative to the start time of each observation. These TOAs are then corrected for offsets in the Parkes time system and for delays due to interstellar dispersion. These are then referred to solar-system barycentre, correcting for both the propagation time and the change in gravitational potential, giving infinite-frequency TOAs in what

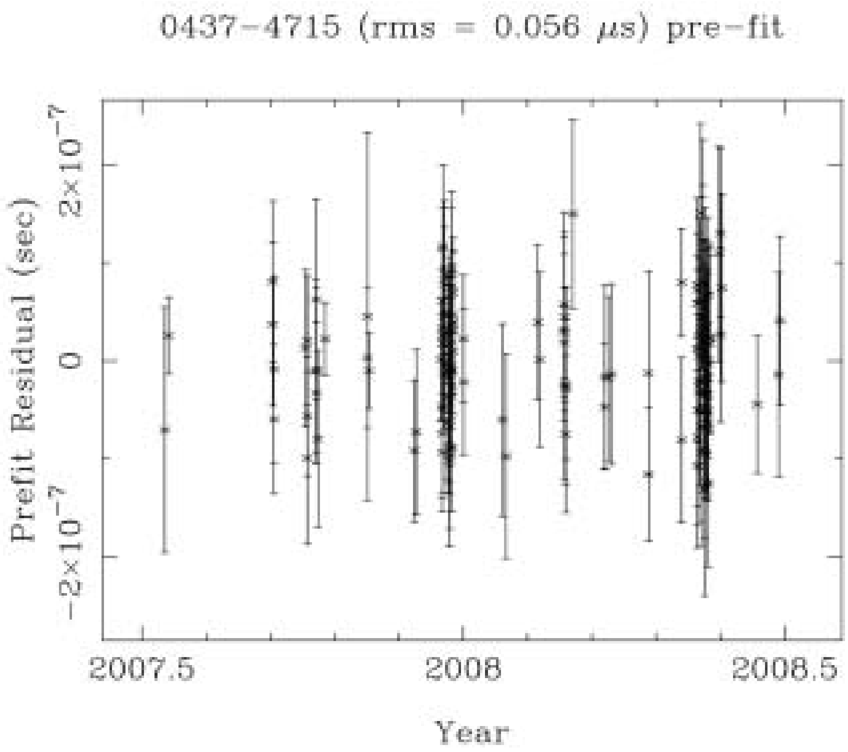


Figure 2: TEMPO2 plot of post-fit timing residuals over one year for 10-cm observations of PSR J0437-4715 using PDFB2. There are a total of 147 TOAs, each from a 1-hour observation, and a total of 10 model parameters were fitted for.

is assumed to be an inertial reference frame. These TOAs are then compared with predicted TOAs based on a model for the pulsar, including its position, proper motion, pulse frequency and its derivatives and binary parameters if appropriate. The difference between the observed and predicted TOAs are known as timing "residuals" and are the basic product of pulsar timing. Systematic variations in these residuals can be used to improve the parameters of the pulsar model and to search for un-modelled effects such as relativistic perturbations in binary parameters or pulse frequency perturbations due to gravitational waves passing over the pulsar or the Earth.

To make a significant detection of the stochastic gravitational-wave background in the Galaxy, we need to have root-mean-square (rms) timing residuals of order 100 nanoseconds for most of our sample. This is a very demanding requirement which has not even been approached in previous pulsar timing observations. However with the PDFB systems we are approaching this level of precision. Figure 2 shows our best result to date, an unprecedented 56 nanosecond rms timing residual over one year for PSR J0437-4715 using the 10-cm receiver and PDFB2. Data processing made use of the PSRCHIVE and TEMPO2 software systems.

While our current results constitute the most accurate pulsar timing results ever obtained for such a large pulsar sample, they are not yet sufficiently precise to detect the predicted gravitational-wave background in the Galaxy. We are continuing to work on removal of systematic errors in the data and on improving our processing algorithms. We have also established collaborations with the European and North American pulsar timing array projects (EPTA and NANOGrav, respectively) to form the International Pulsar Timing Array (IPTA). The increased sky coverage and number of observations afforded by the IPTA will considerably enhance the chances of a successful detection of gravitational waves. Looking further into the future, the enormous sensitivity of the Square Kilometre Array will allow observations of a much larger sample of pulsars, making possible not only detection of gravitational waves, but detailed study of both the waves and the sources that emit them.

Figure 3: Commissioning of the five export PDFBs at Parkes on 13 October 2008.

From left, the people are Hongfei Liu (National Astronomical Observatories, Chinese Academy of Sciences (NAOC), Beijing), Zhiyong Liu (NAOC, Urumqi Observatory), Tim Ikin (Jodrell Bank Centre for Astrophysics, University of Manchester), Maozheng Chen (NAOC, Urumqi Observatory), Dick Manchester (ATNF), Andrew Brown (ATNF), George Hobbs (ATNF) and Warwick Wilson (ATNF).

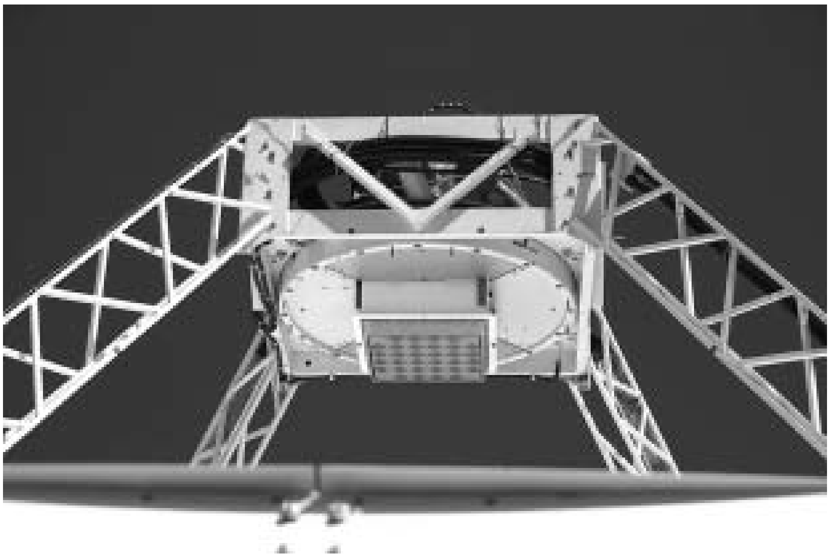
Photo: John Sarkissian, CSIRO

The outstanding performance of the PDFB systems is a tribute to the ATNF engineers and scientists who designed and constructed them. As an illustration of the impact of the development of these systems, the ATNF has just completed construction and testing of five systems under contract to other observatories around the world, three in Europe and two in China. Before shipment, these systems were all tested at Parkes. Figure 3 shows five systems in the Parkes tower with the team of ATNF and visiting engineers and scientists involved in the commissioning.

The design and construction of the PDFB systems was led by ATNF engineers Grant Hampson, Andrew Brown and Warwick Wilson, with major contributions from John Reynolds, Evan Davis, Paul Roberts, Michael Kesteven and Mark Calabretta.

ASKAP Update

Diana Londish (ATNF)



Above: The 5x4 chequerboard-design phased array feeds installed at the focus of the Parkes Testbed Facility antenna.

Photo: David McClenaghan, CSIRO

Below: ASKAP team members enjoy a 3-D show of the antenna build process. (See also front cover.)

Photo: Carole Jackson, CSIRO

Commonwealth Parliamentary Standing Committee on Public Works

The Commonwealth Parliamentary Standing Committee on Public Works is tasked with reviewing proposed expenditure of public money, and preparing and presenting reports and recommendations for Parliament. Documentation on the Australian Square Kilometre Array Pathfinder (ASKAP) was submitted by CSIRO to the committee in June 2008 and the in camera and public hearings took place on 1 October in Geraldton. The Committee's report was tabled in the Commonwealth Parliament on 1 December, expressing support for the ASKAP project as part of the continued development of radio astronomy in Australia. The motion was approved by Parliament on 3 December.

ASKAP Science

An ASKAP User Policy Taskforce has been set up to determine access policies for both large surveys and small general science experiments. Issues dealt with include user support, open access policies, and the interaction with the international Virtual Observatory community. A workshop to discuss synergies between proposed ASKAP surveys and planned optical and infrared surveys was held in Melbourne from 24 – 26 September, hosted by Swinburne University of Technology. A call for Expressions of Interest (EoI) to be involved in designing and implementing an initial set of Survey Science Projects for ASKAP was issued on 1 November, with submission deadline 15 December. This has resulted in 38 submissions from Principal Investigators in10 different countries.

Information relating to ASKAP science, call for EoIs and User Policy can be found on the ASKAP web pages at *http://www.atnf.csiro.au/projects/askap/*

MRO

At the end of September a new temporary hut was deployed on site at the Murchison Radio-astronomy Observatory (MRO) for the Murchison Wide-field Array (MWA) project and the old MWA caravan was removed. Other upgrades and activities included placement of a portable generator for temporary additional power, upgrading of air-conditioners on the MWA hut, dressing of cables to MWA tiles, installation of additional receivers in the MWA hut to support more tiles (up to 32), installation of beamformers, testing of the 8-tile (8T) system and general data collection. By the end of November, 26 MWA tiles were operational, and the remaining six tiles will be brought on line in January. Following the installation of the system test science observations were made of the Sun, and the data were processed at Curtin University of Technology in Perth.

RQZ

Further protection for the MRO radio-quiet zone (RQZ) was put into place during 2008 with the Western Australian (WA) government adopting the technical standards and assessment procedures recommended by CSIRO to manage its declared Mineral Resource Management Area (MRMA) under the WA Mining Act. The conditions require the licensee or lessee of all new mining leases and licences within 80 km of the centre of the MRO to submit a plan of activities to the WA Government for approval. A duly approved Radio Quiet Management Plan must henceforth be included with any Program of Work or mining proposal submitted to government, for those mining activities that fall within the MRMA zone.

Antenna tender

The ASKAP antenna Request for Tender (RFT) closed in May 2008 and a tender evaluation process was run to the plan set out in the Tender Header Document, with visits being made to shortlisted tenderers.

On 3 November CSIRO announced that the major contract for the antennas was awarded to the 54th Research Institute of China Electronics Technology Group Corporation (known as CETC54). CETC54 will supply thirty-six 12-m antennas for under A$10 million, meeting a key cost target of under $300,000 per delivered antenna. A critical design review (CDR) was held 17-19 December, in China at CETC54's premises.

Parkes Testbed Facility

The ASKAP project has developed the Parkes Testbed Facility (PTF) based on a 12-m diameter prime focus antenna built by Patriot Antenna Systems at Parkes Observatory. Its purpose is to test the CSIRO-developed phased array feeds (PAF). The Parkes 64-m dish provides a platform for deeper, more sensitive testing of the PAF in tandem with the PTF.

The PTF pedestal houses an ASKAP-style beamformer, antenna control and monitoring systems. In addition a trial forced-air ventilation system was installed, providing cooling to these sensitive components.

In mid-May a group of 30 ASKAP team members travelled to Parkes to view the PTF and plan for the PAF tests.

As well as being able to check out the antenna and the facilities installed at Parkes to support the PTF (including a new RFI-screened room in the woolshed), the team enjoyed the 3-D show of the antenna build process and a "hay ride" on the 64-m dish capped off the day.

A major milestone was reached on 24 July when the first prototype PAF was hoisted onto the antenna, and testing began the following Sunday. On Tuesday 29 July the team captured signals from eight of the total 40 ports and "first light" was thus declared.

Testing of the PAF, as well as the analogue, digital and computing systems is continuing. In September this included interferometry between the 12-m dish and the Parkes 64-m dish using all 40 elements of the PAF, a major step in demonstrating that the array performs as expected. The PAF was returned to Marsfield in late November for refitting with upgraded components.

Digital signal processing/Computing

The architecture for the digital system has been completed, and the team is developing the details and path to delivery. The Concept Design Review is completed, and the Preliminary Design Review was held on 5 December.

The ASKAP project is preparing a call for Expressions of Interest to collaborate on the development of a single digital backend with the ASKAP project; this will be opened on AusTender in early 2009.

Industry Engagement ramps up for ASKAP

Phil Crosby and Carole Jackson (ATNF)

As ASKAP focuses on the establishment of the MRO site in readiness for the delivery of the Boolardy Early Test Array (BETA) in mid-2010, there has been a corresponding increase in industry engagement activities over the past six months. The focus is now shifting from overview and planning briefings for industry, to practical engagement and involvement.

Highlights of the past period are:

- New or increased collaborative R&D activities established with IBM, Cray, Intel, Mesaplexx and PPM.
- An SKA power generation workshop held at CSIRO Energy

Technology in November to examine technologies and distil options for ASKAP and SKA sustainable power requirements. The workshop was supported by Solar Systems, Horizon, Spectrolab, Worley Parsons, as well as Government stakeholders.

- ASKAP has sub-contracted strategically-important work packages to:
  - SKM, Parsons Brinckerhoff, and WT Partnerships to prepare elements of the submission, design and costings for the (now successful) submission to the Parliamentary Standing Committee for Public Works;
  - AARNet for the design study for the fibre optic link from Geraldton to the MRO.

  Both of these are now complete, and planning for the next phase activities is underway.
- Two editions of the Australian SKA Industry Capabilities Directory have been published to showcase Australian based businesses with SKA relevant capabilities. The Directory is available on-line, with new businesses able to register at any time. The Directory currently has over 350 businesses registered.
- Release of the ***ASKAP Industry Opportunities Register (IOR)*** and the companion pamphlet, the ***Australian Industry Participation Plan (AIPP)*** is also publicly available from the ASKAP website. Both have received very positive feedback from industry and other stakeholders.
- The Australian SKA Industry Consortium (ASKAIC), a group of companies with a strong interest in ASKAP and the SKA, continues to support the project and meet regularly to plan collaborative, self-funded activities to support the Australian SKA bid. ASKAIC provides a forum for industry engagement issues to be raised and addressed.
- Minister Carr hosted the 2nd "CEO's dinner" at Parliament House on Tuesday 11 November. Brian Boyle, Phil Crosby and Carole Jackson attended from CSIRO. Feedback has been positive, and it seems that this will now be a permanent fixture on ASKAIC's annual calendar of events.
- On Monday 17 November, 18 ASKAIC members visited Parkes Observatory to view the ASKAP test-bed, the 64-m dish and hold a regular ASKAIC steering committee meeting. John Reynolds and Brett Preisig contributed to the success of this visit, showing all our visitors the professional, dedicated observatory team.

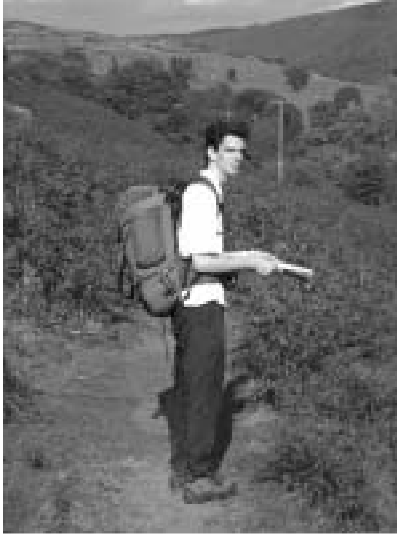
General industry briefings have continued and are complemented by regular editions of the ASKAP Industry Newsletter. Copies of all information distributed to industry stakeholders, presentations and updates can be found at:

www.atnf.csiro.au/projects/askap/industry.html

The ASKAIC group visit the ASKAP test-bed at Parkes: left to right (as much as one can tell under the hard hats!)

Davin Gibb (Cisco), Peter Elford (Cisco), Charlie Williams (RFS), Michael Matthews (RFS), Dan Credazzi (Visionstream/Leightons), Tony Combes (SGi), Shane Braendler (BAE Systems Australia), Bruce Robbins (DOIR, WA), John Reynolds (CSIRO ATNF), Dane McCormack (Boeing), John Humphreys (GIC), Chris Farrow (IBM), Glen Welby (Cicso), Matthew Francis (Telstra), Grant Wilson (DIISR), Peter Shelley (Raytheon), Brett Preisig (CSIRO ATNF), Carole Jackson, (CSIRO ATNF), Glen Wightwick (IBM), Brendan Bourke (Horizon Power), Janice Humphreys (GIC).

Photo: John Sarkissian, CSIRO



New Postdoctoral Fellows and Research Scientist

Robert Braun and Naomi McClure-Griffiths (ATNF)

From the top:

Dr Dominic Schnitzeler,
Dr James Green,
Dr Bjorn Emonts,
Dr James Urquhart,
Dr Shami Chatterjee.

Photos courtesy of those pictured.

Dr Dominic Schnitzeler started at the ATNF on 18 August 2008 as a postdoctoral fellow. Dominic studied undergraduate astrophysics at Leiden University, where he also completed his PhD in May 2008 working on how Rotation Measure Synthesis can be applied to study the magnetised Galactic warm interstellar medium (ISM). At the ATNF Dominic will work with Naomi McClure-Griffiths on how we can probe the Galactic magnetic field using the Zeeman effect, and he is also interested in collaborating with people who want to use Rotation Measure Synthesis. Outside office hours Dominic can be spotted hiking in the countryside.

Dr James Green joined the ATNF on 7 August 2008 as a postdoctoral fellow. Jimi studied undergraduate astrophysics at Cardiff University, before completing his PhD in 2008 at the Jodrell Bank Centre for Astrophysics, studying high-mass star formation and Galactic structure through the Methanol Multibeam Survey. Jimi will be working in Naomi McClure-Griffiths's group on the Galactic distribution of regions of high-mass star formation together with their magnetic field structure. Jimi is an avid Liverpool Football Club supporter, as well as keenly pursuing a worldwide exploration of beers. Jimi has moved to Australia with his wife Alison.

Dr Bjorn Emonts began his Bolton Fellowship at the ATNF on 1 September 2008. Bjorn did both his undergraduate work and PhD research at the University of Groningen, where he completed his thesis, entitled ***Nearby Radio Galaxies: the interplay of gas, star formation and active nucleus***, in 2006. Subsequently he was awarded a Rubicon post-doctoral fellowship to continue his research at Columbia University. At the ATNF, Bjorn plans to concentrate on understanding the cold ISM in low- and high-redshift radio galaxies, making extensive use of the millimetre capabilities of the ATCA.

Dr James Urquhart started at the ATNF on 15 September 2008 as a CSIRO Office of the Chief Executive post-doctoral fellow. James completed his undergraduate work at the University of Sussex and went on to complete his PhD at the University of Kent, where he completed his thesis, on ***Radio Surveys of Triggered Star Formation within Bright-rimmed Clouds***, in 2004. Since that time he has been working as a post-doctoral research assistant at the University of Leeds. James will be continuing his study of massive star formation in the Galaxy at the ATNF in the context of his ***Star Formation through Cosmic Time*** post-doctoral appointment, in collaboration with Kate Brooks and Robert Braun. James has come to Australia with his partner, Lucy, and they are looking forward to a great deal of bush-walking.

Dr Shami Chatterjee began his appointment as Astrophysics Research Scientist at the ATNF on 8 December 2008. Shami completed his PhD at Cornell University in 2003 and has subsequently held a Jansky Fellowship at the Harvard-Smithsonian Center for Astrophysics and National Radio Astronomy Observatory in Socorro and most recently a Post-doctoral Fellowship at the University of Sydney. His current research interests cover: (a) the radio transient sky, (b) compact objects: neutron stars and black holes, and (c) high precision astrometry. He brings a wide range of interests and expertise to our Astrophysics group and we look forward to working together.

Please join us in welcoming Dominic, Jimi, Bjorn, James and Shami to the ATNF.

ATNF Graduate Student Program

Bärbel Koribalski (ATNF)

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

- Sarah Burke (Swinburne University of Technology) ***The Symbiosis between Cosmological Evolution Models and Millisecond Pulsars*** with supervisors Prof Matthew Bailes (Swinburne University of Technology), Dr David Barnes (Swinburne University of Technology), Dr Simon Johnston (ATNF) and Dr Dick Manchester (ATNF).
- Joanne Dawson (Nagoya University) ***Supershells as Molecular cloud factories in the Evolving ISM*** with supervisors Prof Yasuo Fukui (Nagoya University) and Dr Naomi McClure-Griffiths (ATNF).
- Andres Guzman (Universidad de Chile) ***Ionised jets and molecular outflows in high-mass young stellar objects*** with supervisors Prof Guido Garay (Universidad de Chile) and Dr Kate Brooks (ATNF).
- Aquib Moin (Curtin University of Technology) ***e-VLBI science with the LBA – exploring science applications for the long baseline component of ASKAP*** with supervisors Prof Steven Tingay (Curtin University of Technology) and Dr Chris Phillips (ATNF).
- Minnie Mao (University of Tasmania) ***Cosmic Evolution of Radio Sources*** with supervisors Dr Jim Lovell (University of Tasmania), Dr Rob Sharp (Anglo Australian Observatory) and Prof Ray Norris (ATNF).
- Anne-Marie Brick (University of Tasmania) ***Galactic Structure and Methanol Masers*** with supervisors Dr Simon Ellingsen (University of Tasmania), Dr Jim Lovell (University of Tasmania) and Dr Chris Phillips (ATNF).
- Kate Randall (University of Sydney) ***Discriminating between AGN and SFG in ATLAS*** with supervisors Dr Andrew Hopkins (University of Sydney) and Prof Ray Norris (ATNF).
- Christopher Hales (University of Sydney) ***Radio Polarisation and the Origin of Galactic and Intergalactic Magnetic Fields*** with supervisors Prof Bryan Gaensler (University of Sydney), Dr Enno Middelberg (University of Bochum, Germany) and Prof Ray Norris (ATNF).
- Elizabeth Mahony (University of Sydney) ***Understanding the High-Frequency Radio Source Population*** with supervisors Prof Elaine Sadler (University of Sydney), Dr Scott Croom (University of Sydney), Prof Ron Ekers (ATNF) and Dr Ilana Feain (ATNF).
- Keith Bannister (University of Sydney) ***Archival and Future Searches for Radio Transients*** with supervisors Prof Bryan Gaensler (University of Sydney) and Dr Tim Cornwell (ATNF).

Congratulations to:

- Martin Leung on the successful submission of his University of Sydney PhD thesis on ***A wideband feed for a cylindrical radio telescope***.
- Xiaopeng You on the successful submission of his Chinese Academy of Sciences PhD thesis on ***The propagation of pulse signals in interstellar medium and their effect on the detection of gravitational waves***.
- Janine van Eymeren on the successful submission of her University of Bochum (Germany) PhD thesis on ***Gas Kinematics in the Haloes of Nearby Irregular Dwarf Galaxies***, and
- Vicky Safouris on the successful submission of her Australian National University PhD thesis on ***Environmental Influence on the Evolution of Jets from Active Galactic Nuclei***.

Dr Janine van Eymeren is now at the University of Manchester, UK, and Dr Xiaopeng You at the School of Physical Science & Technology, Southwest University, China.

The following students recently submitted their PhD Thesis:

- Adam Deller (Swinburne University of Technology): ***Precision VLBI astrometry: Instrumentation, algorithms and pulsar parallax determination***.
- Marcella Massardi (International School for Advanced Studies (SISSA), Trieste): ***The extragalactic sources at mm wavelengths and their role as CMB foregrounds***.
- Emil Lenc (Swinburne University of Technology): ***Studies of Radio Galaxies and Starburst Galaxies using Wide-field, High Spatial Resolution Radio Imaging***.

ATNF distinguished visitors

Robert Braun (ATNF)

Over the past months we have enjoyed working visits from Cesar Estaban (Instituto de Astrofísica de Canarias), Jay Lockman (National Radio Astronomy Observatory), Jayanne English (University of Manitoba), Martin Cohen (University of California, Berkeley), Simon Driver (University of St Andrews), Peter Kalberla (University of Bonn), Patrick Hennebelle (Paris Observatory), D J Pisano (National Radio Astronomy Observatory) and Barney Rickett (University of California, San Diego).

Current visitors include Ingrid Stairs (University of British Coumbia).

Upcoming visitors we expect include Marta Burgay (University of Cagliari), Leo Blitz (University of California, Berkeley) and Jim Cordes (Cornell University).

The Distinguished Visitors Program remains a very productive means of enabling collaborative research projects with local staff, adding substantially to the vitality of the ATNF research environment.

Visits can be organised for periods ranging from only a few weeks up to one year.

For more information please see

www.atnf.csiro.au/people/distinguished_visitors.html.

Prospective visitors should contact the local staff member with the most similar interests.

8th ATNF Synthesis Imaging School

Phil Edwards (ATNF)

The ATNF held its 8th Synthesis Imaging School from Monday 29 September to Friday 3 October 2008 at the Australia Telescope Compact Array (ATCA). The format was similar to previous Schools, with lectures by radio astronomers and engineers as well as practical sessions involving ATCA observing and data reduction. A total of 32 students attended the school, with about a quarter of these being members of the Australian SKA Pathfinder (ASKAP) team.

The first day commenced with an introduction to the ATCA by Phil Edwards, followed by lectures on the principles of interferometry by Ron Ekers and Rick Perley. Ron's illustration of the importance of phase and amplitude using Fourier transforms of a duck and a cat was particularly memorable!

Top: The wood-fired pizza oven proved a popular choice.

Bottom: Andrew Walsh with a spell-bound audience during his after dinner talk *Complex Molecules in Space, and Can We Make Beer out of them?*

Photos: Joanne Houldsworth, CSIRO

After lunch Graeme Carrad spoke on receiver systems and Dick Ferris gave an introduction to correlators and the Compact Array Broadband Backend (CABB), before Ilana Feain gave an overview of ASKAP and the SKA. The day concluded with the conference dinner at the Outback Shack in Narrabri.

Robert Braun opened proceedings on Tuesday with an entertaining description of Fourier transforms, which Mark Wieringa put into practice during talks on calibration and editing, and imaging and deconvolution. Andrew Walsh rounded out the morning with a description of spectral line observing.

The Tuesday, Wednesday and Thursday afternoons were devoted to tutorial sessions.

During these sessions all participants were given a tour of an antenna and the screened room, introduced to the ATCASCHED scheduling tool, shown how to observe with the ATCA, and given the opportunity to reduce one (or more) example datasets. In addition, on the Tuesday afternoon Tara Murphy gave a talk on the ***Radio-Astronomers IT Toolkit***, describing various tools and strategies for dealing with data.

Participants and helpers from the synthesis imaging school outside the Visitors Centre in front of two antennas from the Compact Array.

Photo: Jock McFee, CSIRO

Wednesday morning's program started with Bob Sault describing sensitivity and Steven Tingay explaining self-calibration. After coffee, Ron Ekers gave a talk on error recognition, and Cormac Reynolds extended the imaging techniques to continental and intercontinental baselines. Wood-fired pizzas were cooked on-site Wednesday evening, and diners entertained by Andrew Walsh's exposition on ***Complex Molecules in Space, and Can We Make Beer out of them?***

Bob Sault introduced mosaicing on Thursday morning, which was followed by a talk on data analysis by Naomi McClure-Griffiths. A 20th birthday cake was wheeled in for the coffee break, and a rousing version of ***Happy Birthday*** was sung to the ATCA. After the break, Jessica Chapman introduced OPAL (Online Proposal Applications & Links) and ATOA (Australia Telescope Online Archive) and gave some tips on proposal writing. Dave McConnell impressed the audience with his manual dexterity in combining rotating polarisation vectors, and participants literally had a ball with his example of a Poincaré Sphere! Rick Perley followed Dave's introduction to polarimetry with a more detailed study of the topic as a tutorial for the more advanced students after lunch.

The School finished on Friday with an introduction to advanced data reduction by Maxim Voronkov, and a flying tour of telescopes of the world by Phil Edwards. Participants were then invited to complete a questionnaire on the School, with the feedback received being overwhelmingly positive. A common theme was the appreciation of lectures that were interesting and engaging, with lots of pictures and examples and containing practical advice that couldn't be learnt by simply reading a book. The hands-on experience provided by the tutorial sessions was similarly valued.

Tutorial sessions were ably led by Christoph Brem, Kate Brooks, Jock McFee, Scott Munting, Robin Wark and Tobias Westmeier, with contributions from a number of lecturers. The efforts of all Narrabri staff in preparing for the school and ensuring it ran smoothly are greatly appreciated, with the tireless behind-the-scenes work of Jo Houldsworth and Marg McFee particularly noteworthy.

Financial assistance from the Donovan Trust and Curtin University of Technology is gratefully acknowledged. As always, a vital ingredient in the School's success was the attendance and active participation of students from across Australia and from overseas. As they are representatives of the next generation of array users, we can be confident the ATCA's future is in capable hands!

Twenty years of the Australia Telescope Compact Array

Helen Sim (ATNF)

The Australia Telescope Compact Array turned twenty this year. (On 2 September, to be precise.) Twenty, if you're a telescope, is a good age at which to reflect: to look both backwards and forwards. The Compact Array Science Day on 11 June 2008 largely looked to the future. But what is that future based on? Where is the Compact Array now, and where has it come from?

The Compact Array: Greatest Hits

Phil Edwards, the ATNF's Head of Science Operations, has plucked from the Astrophysics Data System (ADS) the top twelve most highly cited papers using Compact Array data, all with more than 100 citations. While cautioning that this sample will be biased towards papers more than five years old, he describes the results as "very interesting".

Three of the top four papers use target-of-opportunity observations, and date from the late 1990s. "This was the era when satellites were starting to pinpoint gamma-ray bursts with sufficient accuracy that they could be followed up at radio wavelengths," Phil said. In fact, the most highly cited paper was not just an observation of a gamma-ray burst, but crucial evidence that these bursts were linked to supernovae. The three most highly cited papers, and another two in the list (Corbel et al. and Schwarz et al.) are multiwavelength. Two of the papers (Tingay et al. and Schwartz et al.) included both Very Long Baseline Interferometry (VLBI) data that the Compact Array contributed to, and stand-alone Compact Array data. And, not surprisingly, the target-of-opportunity papers – in fact, all 12 papers – are in the list by virtue of the Compact Array being both in the Southern Hemisphere and having high angular resolution (i.e. being an interferometer).

The rest of the list is diverse, and perhaps less predictable, covering observations of ultracompact HII regions, methanol masers, and quasar scintillation. "It's not all continuum, it's not all hydrogen," said Phil. "There's a very wide range of science topics in that top twelve."

"Two of the most cited and influential papers are the hydrogen (HI) mosaic images of the Large Magellenic Cloud (LMC) and Small Magellenic Cloud (SMC)," added Ron Ekers, former ATNF Director. "These were the most dramatic examples of the use of the mosaicing technique, which was really introduced into the astronomy community by the Compact Array."

Two of the papers represent observations that lay outside the obvious range of the Compact Array's capabilities. "The 6.7 GHz observations of methanol masers are interesting, because 6.7 GHz is outside the nominal range of frequencies the Compact Array can observe at," said Phil. (Methanol masers were unknown at the time the Compact Array was designed). "Apparently the engineers took some convincing to allow observations to be made at 6.7 GHz," said Phil. "But it was tried and indeed proved to be possible." The observations of intra-day variability from the quasar PKS 0405-385 were not technically challenging, he said, but represented a mode of observing that wasn't envisaged when the Compact Array was built. The recently completed AT20G survey is too new on the scene to be a candidate for the "top 12" list, but it too has taken the Compact Array into uncharted technical waters by mapping the sky with continuous slewing. It also used an innovative wideband analogue correlator developed by ATNF engineers for a completely different purpose – a cosmic microwave background experiment.

A few other notable pieces of Compact Array research haven't made it into the "top 12" because they were fairly specialised.

One is the ground-breaking observation of SNR1987a in 1991. This was the first imaging of the birth of a radio supernova remnant, and provided the impetus to get the 6-km antenna of the Compact Array working. A second instance is the 3-D tomographic images of Jupiter's radiation belts. These observations, led by former Narrabri Officer-in-Charge Bob Sault in 1995, were "perhaps the most innovative" that have ever been made with the Compact Array, according to Ron Ekers. And observations exploiting the Compact Array's exceptional polarisation purity have been small in number, but excellent. The observations of circular polarisation in BL Lacs by PhD student David Rayner have never been bettered, said Ron Ekers, and those of circular polarisation in the intra-day variable source PKS 1519-273 by J-P Macquart "might turn out to be one of the most important Compact Array discoveries", he said.

The last time anyone looked (Trimble & Ceja 2008 AN, 329, 623-647), the Compact Array ranked second in the world in terms of the total number of citations (this was for the years 2001-

2003), second only to the VLA (Parkes was a close third). It is a proud record, built on good design choices, excellent engineering, operational efficiency, and the openness of a National Facility to the best observing proposals.

Growth and learning

The Compact Array has had three major technical upgrades, says Dave McConnell, Officer-in-Charge of the Paul Wild Observatory during 1997–2001 and now the ATNF's Assistant Director: Operations. The most obvious to users has been the outfitting of the Compact Array to handle 12- and 3-mm wavelengths. This was a major overhaul, funded by the first round of the Commonwealth Government's Major National Research Facilities (MNRF) program over several years, and involved creating new receivers, building the north spur track, resurfacing the antennas, and reconfiguring the Local Oscillator (LO) distribution system. The second upgrade, completed in 2008 and done in collaboration with NASA, has given the Compact Array an additional 7-mm capability for both astronomy and spacecraft tracking. The third upgrade, which will be completed next year, is the Compact Array Broadband Backend (CABB) project (described at ***http://www.narrabri.atnf.csiro.au/observing/CABB.html***). CABB was funded by a second round of the MNRF program. Both the millimetre-wave upgrade and CABB competed successfully in their respective MNRF rounds against bids from all areas of Australian science, not just astronomy.

These upgrades were on a natural development path for the Compact Array. For instance, for the LO system, modified under the first-round MNRF program, "the eventual need for higher

The 12 most highly cited Compact Array papers

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- Kedziora-Chudczer, L.; Jauncey, D. L.; Wieringa, M. H.; Walker, M. A.; Nicolson, G. D.; Reynolds, J. E.; Tzioumis, A. K. **PKS 0405-385: The Smallest Radio Quasar?** 1997 ApJ 490, L9.

Above: The Compact Array in a compact configuration Photo: Phil Edwards, CSIRO bandwidth had been foreseen," said Dave. "We took advantage of new technology when it became available." CABB, which will provide the Compact Array with much greater sensitivity, has arisen for the same reasons. The millimetre-wave upgrade too was foreseen, or at least provided for in the initial specifications: the antennas were originally specified to operate at frequencies well above the 8 GHz upper frequency allowed for in the construction budget. However, the antenna designers were careful not to push the requirements above 7 mm to avoid cost over-runs. The decision to upgrade the Compact Array for 3-mm observations was carefully considered in the mid 1990s in light of the site's characteristics, but "I think it has been worth the risk," said Dave. This extension of the Compact Array's capabilities opened the instrument up to new uses: for instance, studies of higher-frequency masers and molecular species such as carbon monoxide (CO) in high-redshift galaxies.

The changes fostered the development of specific capabilities within the ATNF. The receiver group took on the challenge of designing high-frequency receivers, "and developed their capability enormously," said Dave. And in the area of correlators, the ATNF came to grips with high-speed data transport: technologies that flow directly through to ASKAP. " Again, a very strong group, but they had to extend themselves," said Dave. CSIRO, he says, wants to identify the capabilities the ATNF has "that are unusual and give us an advantage in particular areas of science and technology. The drive [throughout CSIRO] is to recognise the capabilities that CSIRO has that might be valuable, and to do our best to maintain and extend them."

The Compact Array is also a "learning instrument" for observers, particularly students. There are a dozen new students joining the ranks of observers each year, Phil said. "And they find it very inspiring to come to the telescope." The Duty Astronomy scheme keeps ATNF staff current with the telescope, he says. Because project proposers are also the observers, there is a steep learning curve for first-time observers, but "we also learn from them," said Phil. "They ask questions such as 'why can't I do this?'". Remote observing has accounted for about 15% of all observing with the Compact Array for the past five years. As this proportion increases, there will have to be other ways found to maintain interactions with observers, Phil suggests.

The next five years

What of the future? The new Compact Array Broadband Backend, to be installed in March/April 2009, will hugely enhance Compact Array science and enable projects that were not feasible before. This is particularly true for millimetre-wave projects, which will benefit from increased sensitivity and bandwidth. Combined multi-line and wideband continuum observations will be the Compact Array's standard observing mode in the future. The Compact Array will soon be operating in an environment where the Atacama Large Millimeter Array Project (ALMA), the Australian Square Kilometre Array Pathfinder (ASKAP) and the Expanded Very Large Array Project (EVLA) will give the world's astronomers new observing possibilities, but there are several areas – for instance, wide and deep continuum surveys, niche HI surveys, studies of radio transients, and 3-D imaging of magnetic fields – in which the Compact Array will continue to do excellent science.

What will be the most highly cited papers of the future? The Compact Array's deep surveys will be among them, predicts the ATNF's Ray Norris. The Compact Array has been used for four deep surveys: PHOENIX, ATESP, the radio counterpart of the Hubble Deep Field South, and ATLAS, which builds on the multiwavelength data available in fields such as the Chandra Deep Field South. All have gone deep; ATLAS has also gone wide, covering seven square degrees. Such radio surveys, says Ray, have become particularly important at the current time, when our understanding of galaxy evolution, and of the star-formation history of the universe, is changing rapidly. "As an east-west array, the Compact Array is particularly good for viewing wide fields, and of course it has had an excellent correlator," said Ray. "Those factors have made it one of the world's best radio survey instruments."

Radio monitoring of transient sources (such as gamma-ray bursts, supernovae and others) is also likely to be a future source of highly cited papers, predicts Bärbel Koribalski, Deputy Leader of the ATNF's Astrophysics Group. "With CABB, follow-up of such events will be faster and deeper than before," she said. The immediate future promises rich pickings for the Compact Array in follow-up detections from new satellites such as Fermi (which monitors gamma-ray sources) and Planck (which will operate in the millimetre and submillimetre bands). But the mostly highly cited Compact Array papers will result from new discoveries made possible by the expanded "parameter space" CABB will provide, Bärbel says. "Flexibility" and "variety" are likely to remain the watchwords for success in the future – along with the in-depth knowledge and imagination of the observers.

Memorandum of Understanding (MOU)

Kate Brooks (ATNF)

CSIRO's Australia Telescope National Facility and Universidad de Chile signed a memorandum of understanding in April 2008 to facilitate collaboration between astronomers of the Australia Telescope National Facility (ATNF) and the Universidad de Chile (UChile). Working together, these two institutions can have a major impact in observational astronomy in the Southern Hemisphere.

The main method for encouraging collaboration between ATNF and UChile will be through the interchange of researchers, professors and students. Astronomers who come from one institution will be appointed as Visiting Scientist in the host institution. Joint ATNF/UChile research projects utilising Australian facilities and those built in Chile will be particularly encouraged.

The Department of Astronomy at UChile has a strong tradition of astronomical research and education, with a total of 30 academic staff and researchers as well as more than 20 post-graduate students. A major part of the astronomical research carried out by UChile utilises the international observatories built in the northern part of the Chile, which are home to the world's best optical, infrared and millimetre telescopes including ALMA, the Atacama Large Millimetre Array. Once ALMA is operational in 2012 it will offer unprecedented millimetre-observing capabilities for the Southern Hemisphere.

Under the MOU a program of joint postdoctoral fellowships has been established. The fellowship takes the name of Australis Fellow, with Australis being a Latin word referring to the south, which is meant to symbolise the astronomical research in the Southern Hemisphere that the ATNF/UChile Australis Fellow will carry out.

Left to right:

Professor Guido Garay (UChile), Dr Kate Brooks (CSIRO ATNF) and Andres Guzman (UChile and CSIRO ATNF co-supervised student) on the grounds of the Calan Observatory at the University of Chile.

Photo: Courtesy Kate Brooks, CSIRO

ARTICLES

The scattered debris of the Magellanic Stream

Tobias Westmeier and Bärbel S Koribalski (ATNF)

Spanning more than half the sky, the Magellanic Stream and the Leading Arm are among the most prominent gaseous structures in the neighbourhood of the Milky Way. They are widely believed to be the result of tidal interaction between the two Magellanic Clouds and the Milky Way (Yoshizawa & Noguchi, 2003), although ram-pressure interaction could have played a significant role in their formation and evolution (Mastropietro et al., 2005). The Magellanic Stream was first studied over its entire extent by Mathewson et al. (1974), who also noticed its association with the Magellanic Clouds.

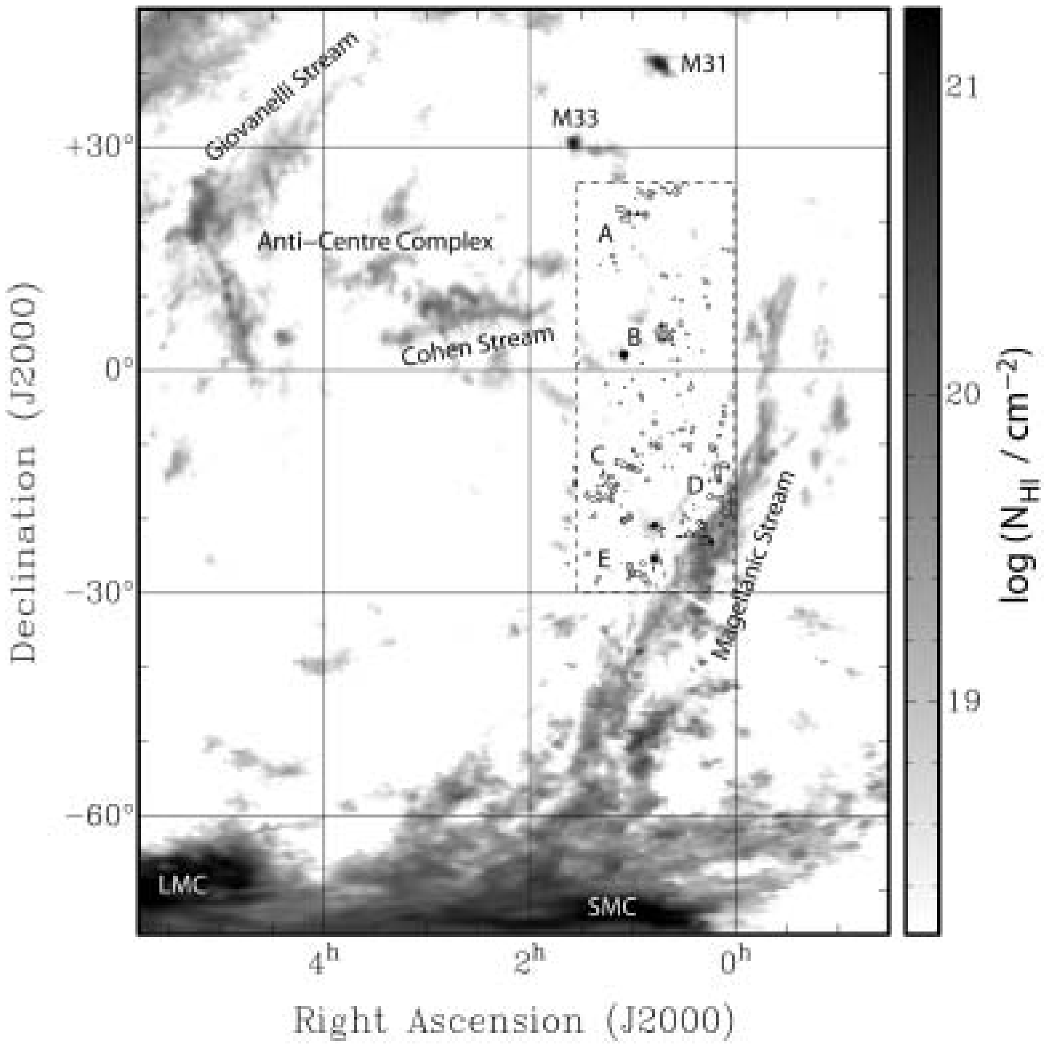

Figure 1: HI column density map of high-velocity gas in a large area on the sky based on the Leiden/Argentine/Bonn survey. The high-velocity clouds (HVCs) found in HIPASS are overprinted as the black contour lines. The identified HVC filaments are labelled with the capital letters A–E. For this project we studied the region of 0h00m to 1h30m in right ascension and -30° to +25° in declination.

Here we report on the detection of an extended, filamentary population of compact neutral hydrogen (HI) clouds most likely connected with the Magellanic Stream (Westmeier & Koribalski, 2008).

The original aim of our project was to search the HI Parkes All-Sky Survey (HIPASS) for a diffuse cosmic web filament connecting the nearby Sculptor group with the M31 group. To do this we searched a large area on the sky (see Figure 1) for diffuse HI emission in HIPASS. The studied area covers about 3% of the entire sky.

We did not find any evidence for a diffuse HI filament connecting the groups but there are numerous high-velocity clouds (HVCs) in this region of the sky (see also, e.g., Putman et al., 2002 and 2003) that appear to be associated with the Magellanic Stream that runs across part of the area studied. We identified 153 potential HVCs, most of which are fairly compact with typical angular diameters of only 20 to 30 arcminutes (full width at half maximum). An HI column density map of high-velocity gas in the entire region, based on the Leiden/Argentine/Bonn survey, is shown in Figure 1 with the detected HVCs overprinted as the black contours. Apparently, their distribution is not homogeneous, but concentrated in filamentary groups which have been labelled with capital letters in Figure 1. Most of these filaments have approximately the same orientation, running from the north-west to the south-east parallel to the Magellanic Stream. This morphology suggests a common origin of the HVCs and a possible association with the stream.

Further evidence for a connection between the detected HVCs and the Magellanic Stream is provided by the kinematics of the clouds. Figure 2 shows the radial velocity distribution of the HVCs as a function of declination. In the local standard of rest frame (LSR, upper panel) we observe a strong velocity gradient of about 3 kms^{-1} per degree. After conversion into the Galactic standard of rest (GSR, lower panel) this gradient completely disappears, demonstrating that the velocity gradient observed in the LSR frame has simply been caused by the projection of the rotation of the Galactic disc. In fact, all

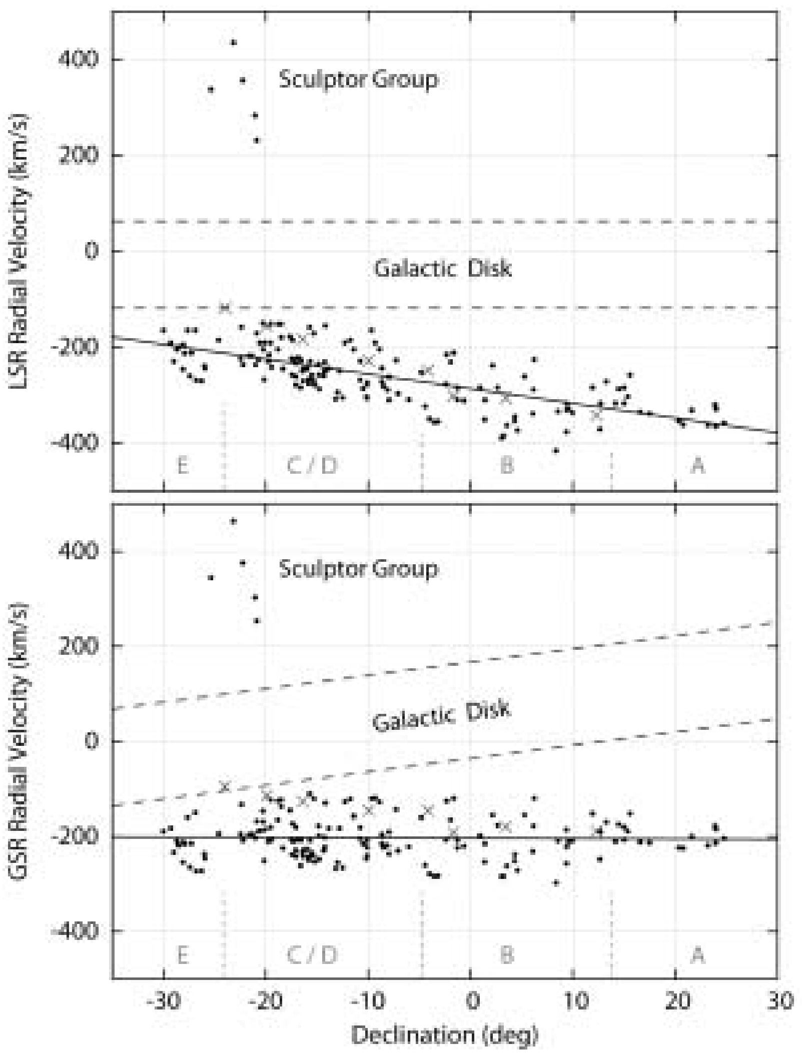

Figure 2: Position-velocity diagrams of the detected HVCs (dots) in the Local Standard of Rest (LSR, top) and Galactic Standard of Rest (GSR, bottom). Five Sculptor Group galaxies found in the region are also plotted. The crosses show the velocities at eight positions along the nearby Magellanic Stream. The solid line is a linear fit to the data, and the capital letters indicate the declination ranges of the filaments outlined in Figure 1.

HVCs have approximately the same GSR velocity with a mean value of $v_{GSR} = -203.0$ kms^{-1} and a remarkably small dispersion of only 43.5 km s^{-1}. Furthermore, the velocities of the HVCs are very similar to those observed along the Magellanic Stream (crosses in Figure 2), suggesting an association of the clouds with the Magellanic Stream.

A comparison of our results with the numerical simulations of Gardiner & Noguchi (1996) provides additional evidence for the origin of the HVCs. In their simulations, the Magellanic Stream and the Leading Arm were formed during the previous perigalactic passage of the Small Magellanic Cloud about 1.5 Gyr ago which approximately coincided with a close encounter between the two Magellanic Clouds. Their model stream consists of two separate parts, a denser main stream which can be identified with the one observed in neutral hydrogen, and a secondary stream with lower surface density which is not observed in HI. A comparison with figure 6 of Gardiner & Noguchi (1996) reveals that the location of the secondary stream coincides with the population of HVCs that we found in HIPASS. Therefore, the discovered HVC filaments could be the neutral part of the faint secondary stream predicted by the simulations of Gardiner & Noguchi (1996). In this case, they would have formed about 1.5 Gyr ago together with the main filament known as the Magellanic Stream.

In addition, Sembach et al. (2003) detected high-velocity ionised oxygen (OVI) absorption against three quasars in the northern part of our field. In all three cases, the radial velocities of the OVI absorbers are similar to those of the HVCs found in HIPASS, suggesting that the HVCs are condensations within a much more extended filamentary network of diffuse and mainly ionised gas. In the case of collisional ionisation, OVI reaches its highest ionisation fraction at a temperature of about 3×10^5 K (Sutherland & Dopita, 1993). Therefore, the OVI absorbers probably trace the interface region between the warm neutral gas of the Magellanic Stream and the highly-ionised Galactic corona.

In summary, our results suggest that the detected HVCs are part of an extended network of neutral and ionised gas filaments associated with the Magellanic Stream. Consequently, the Magellanic Stream would be much more extended than generally believed, with some of the clouds being as far away as 20° from the original stream. A more extensive study of HIPASS data is under way to map the entire extent of the HVC filaments and investigate their connection with other HVC complexes on the sky. In addition, we are planning to follow up observations of some of the clouds with higher angular and spectral resolution using the ATCA. This will allow us to derive the physical parameters of the HVCs and possibly to estimate their distances.

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The nuclear region of NGC 4945 revealed

Emil Lenc (ATNF) and Steven Tingay (Curtin University of Technology)

The central regions of nuclear starbursts are typically obscured by dense clouds of gas and dust, making them notoriously difficult to study at optical wavelengths. However, radio observations provide a means to unveil the shrouds of gas and directly image sources hidden behind them. The recently upgraded Long Baseline Array (LBA) and the Australia Telescope Compact Array (ATCA) have been used to observe the nuclear region of the starburst galaxy NGC 4945 with unprecedented sensitivity and detail. By processing the LBA data with wide-field Very Long Baseline Interferometry (VLBI) techniques, the entire nuclear region was imaged with a resolution of 15 milli-arcseconds (0.3 pc). The resulting images reveal a population of compact radio sources shrouded by dense ionised gas and a jet-like feature that may be associated with a supermassive black hole. These are the "engines" that drive larger-scale features observed at other wavelengths in this galaxy.

NGC 4945 is a nearly edge-on spiral galaxy associated with the Centaurus group of galaxies at a distance of 3.8 Megaparsecs (Mpc). The galaxy has been classified as SB(s)cd or SAB(s)cd and

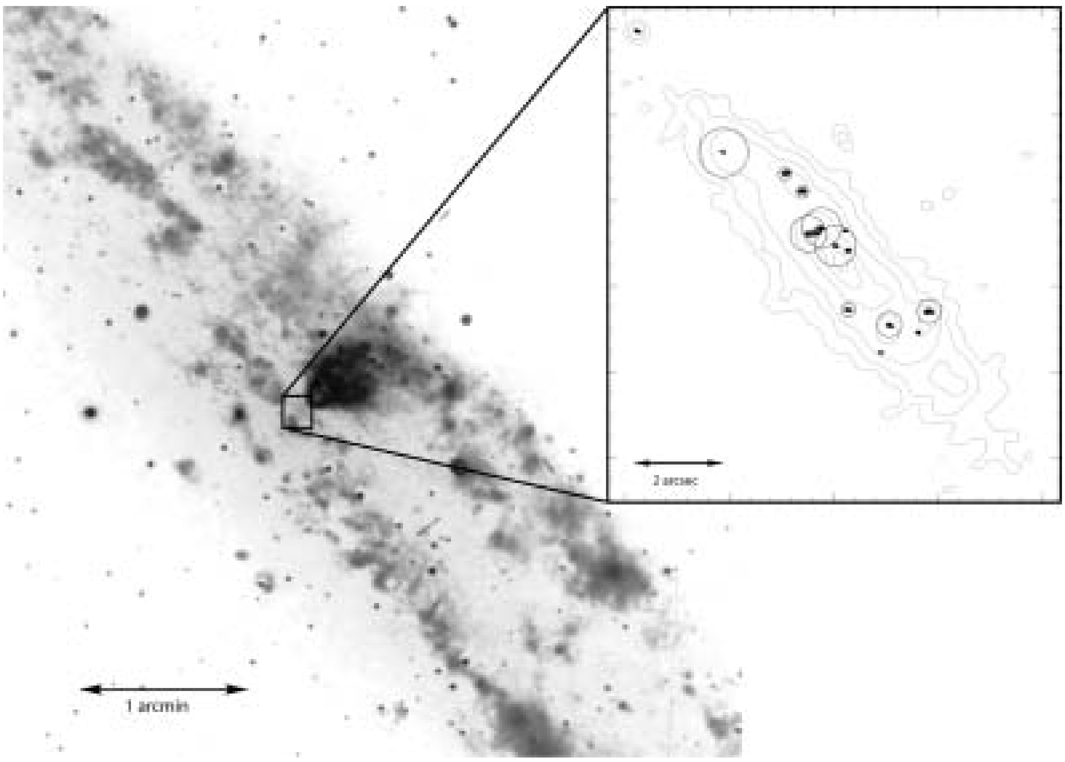

Figure 1: A composite, multi-wavelength view of NGC 4945. Light grey indicates K-band infrared (Jarrett et al. 2003); dark/grey/black Chandra soft X-ray (Schurch et al. 2002); and mid-grey indicates Hα (Rossa & Dettmar 2003). Inset: LBA 2.3-GHz image with ATCA 23-GHz contours overlaid. Circles give an indication of the degree of absorption in the vicinity of the source, with the diameter of the circle being directly proportional to the absorption. (See also cover page.)

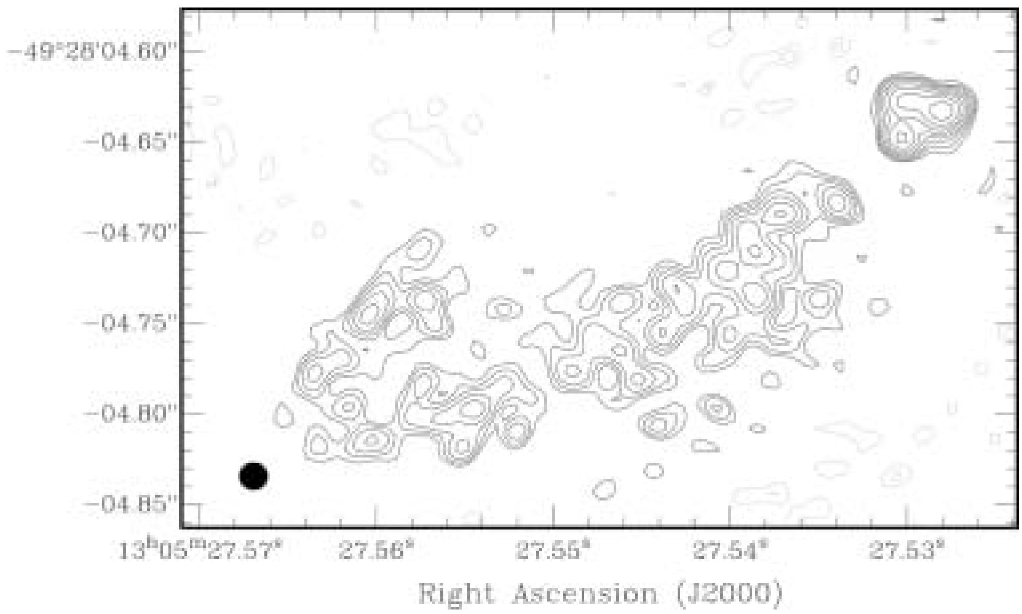

Figure 2: High-resolution LBA image of the jet-like feature discovered in NGC 4945.

has an optical extent of 17 arcminutes. While it is classified as a Seyfert 2 galaxy, it exhibits both starburst and Seyfert characteristics. Evidence of an Active Galactic Nucleus (AGN) comes from strong and variable hard X-ray emission (Isawa et al. 1993) and the detection of a water megamaser in the nuclear region (Greenhill et al. 1997).

NGC 4945 hosts a large number of massive stars that quickly evolve to form supernovae. These supernovae drive activity in the nuclear region over time-scales of 20-30 million years and produce strong winds out of the disk of the galaxy that are visible in X-ray and Hα images (see Figure 1). In NGC 4945, gas is funnelled into the nuclear region by dynamical processes associated with bar instabilities, providing material that feeds the star-forming activity.

The supernova activity in the starburst region is generally hidden from view by dense ionised gas. However, direct observation of supernova remnants in this region is possible at radio wavelengths. Furthermore, Very Long Baseline Interferometry can provide very high angular resolution. Such observations enable us to investigate the remnants themselves, using them to reconstruct the supernova and star formation history of the galaxy. They also provide a link between the large-scale dynamical effects in the galaxy, activity in the star forming region itself, and the energetic phenomena that are in turn driven by the starburst.

Motivated by the existence of compact radio sources (supernova remnants and HII (ionised hydrogen) regions) and strong indicators of free-free absorption in similar starburst galaxies, such as NGC 253 (Lenc & Tingay 2006) and M82 (Pedlar et al. 1999), we embarked on a program of LBA and ATCA observations of NGC 4945. The galaxy was observed at 2.3 GHz over two epochs (separated by 1.9 years) using the LBA to produce the highest resolution images of the nuclear starburst region of this galaxy to date (see Figure 1). Multi-epoch images allowed us to monitor for new supernovae and to check the evolution of existing supernovae and supernova remnants. The LBA observations were complemented with additional data between 8.64 and 23 GHz observed with the ATCA (the 23-GHz image is shown in Figure 1) to determine the spectral indices of the sources and to model the effects of free-free absorption.

A total of 15 compact radio sources were detected with the LBA and 13 of these were associated with sources in the higher frequency ATCA images. Nine sources exhibited spectra that were consistent with free-free absorption, suggesting that they were embedded deep within the nuclear region (the degree of absorption is illustrated with circles in Figure 1). Ten sources had steep intrinsic spectra typical of supernova remnants. In the highest resolution images (15 milli-arcsecond beam), four supernova remnants were resolved into shell-like structures with diameters ranging between 1.1 and 2.1 parsecs (pc.)

The detection of the supernova remnants allowed us to take a number of different approaches towards estimating the type-II supernova rate of the starburst region of the galaxy. An upper limit can be derived from the absence of any new sources between epochs. A lower limit can be determined based on the number of supernova remnants, their sizes and an assumed expansion rate for the remnants. Finally, the supernova rate can also be determined from an estimate of the median age of the remnant population based on the observed flux variation between two epochs.

Our preliminary results, based on only two observing epochs, suggest that the type–II supernova rate is between $0.1(v/10^4)$ and 15.3 per year, where v is the radial expansion velocity of the supernova remnant in km per second. We observed no significant variation between epochs in the detected sources above our error limits. However, if we assume that the median variation in the strongest of sources is real then we find an upper limit of 0.8% per year to the fading rate in NGC 4945. If the supernovae are assumed to fade as the -0.7 power of time (Weiler et al. 1986) then we estimate that the median age of the supernova remnant population of ~85 years. This would imply a supernova rate of ~0.12 per year, a value that falls within the limits determined above.

With only two observing epochs our supernova rate estimates are not highly constrained. The upper limit can be improved with more frequent observations of the source. The lower limit can be further refined once the age of the remnants can be more accurately determined–either by observing expansion in the remnants themselves and thus pinning down the expansion velocity or by observing their fading with a greater degree of certainty. Nonetheless, it is promising that these independent estimates are consistent with each other and are also consistent with similar results obtained from far-infrared, Hα, radio-recombination line and radio continuum observations.

A surprising discovery in the LBA images is that of a one-sided jet-like source in the centre of the nuclear region (see Figure 2). The source extends for approximately 5 pc and has a width of <1.5 pc. A chance alignment of several compact sources in such a linear arrangement is highly unlikely. If it is a jet then it is likely that the source is associated with a supermassive blackhole. The one-sided nature of the jet would suggest that it is either relativistic (with the side facing us being Doppler boosted) or that one side is heavily obscured by the accretion disc surrounding the central blackhole. Similar jet features have been observed in other nearby Seyferts, however, this would be one of the nearest discovered to date. Interestingly, the jet-like source is offset from the assumed location of the AGN (based on the detection of a water megamaser) by approximately one arc-second - an offset that is well outside the positional errors of both observations. The jet-like nature of the source can be confirmed in future observations of the source if motion in the suggested jet is detected.

A detailed analysis of the work presented here has been submitted to the Astronomical Journal for publication and is part of a larger on-going study of the sub-parsec-scale properties of local, bright southern starburst galaxies. Other galaxies in the sample include M83, NGC 55, NGC 253 (Lenc & Tingay 2006), NGC 1313 and NGC 5253. A subsidiary focus of this project is to achieve high sensitivity, high fidelity, high resolution, and computationally efficient imaging over wide fields of view (at least compared to traditional VLBI imaging techniques). The associated exploration of the relevant techniques is a step toward the much larger task of imaging with next generation radio telescopes such as the Square Kilometre Array (SKA).

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Polarisation observations with the LBA

Richard Dodson, University of Western Australia (UWA)

Work has been on-going for the development of full polarisation processing of Very Long Baseline Interfometry (VLBI) data using the Australian Long Baseline Array (LBA) antennas. The results from this analysis are available (Dodson 2007) but we present a summary here to encourage others to use the facility.

Polarisation calibration entails the solving for the fractional polarisation impurities of the right and left handed (or alternatively the two linear) receivers on each antenna (these are the D-terms in the data reduction package, AIPS). This is then included in the calibration application for the formation of the Stokes products (I, Q, U and V).

We have extended AIPS to allow the support of two new mount types; the left-handed and right-handed Nasmyth antennas (Pico Veleta in the Global millimetre VLBI Array (GMVA) and Yebes in the European VLBI Network (EVN)) and the EW-mount (Hobart in the LBA).

A great deal of testing has now been performed, and the updates required have been included in the latest versions of AIPS. A summary of some of the outcomes of these tests are:

The comparison of Australia Telescope Compact Array (ATCA) and LBA was reported in Dodson (2008), which presented LBA observations of the 6.7-GHz methanol maser G339.8-1.26. These are the first ever polarised VLBI images of methanol masers, and also the first polarisation VLBI imaging from the LBA. The telescopes involved were Parkes, ATCA, Mopra, Ceduna (all requiring conventional feed solutions) and Hobart (requiring the solution for the EW-mount type). The target, G339.8-1.26,

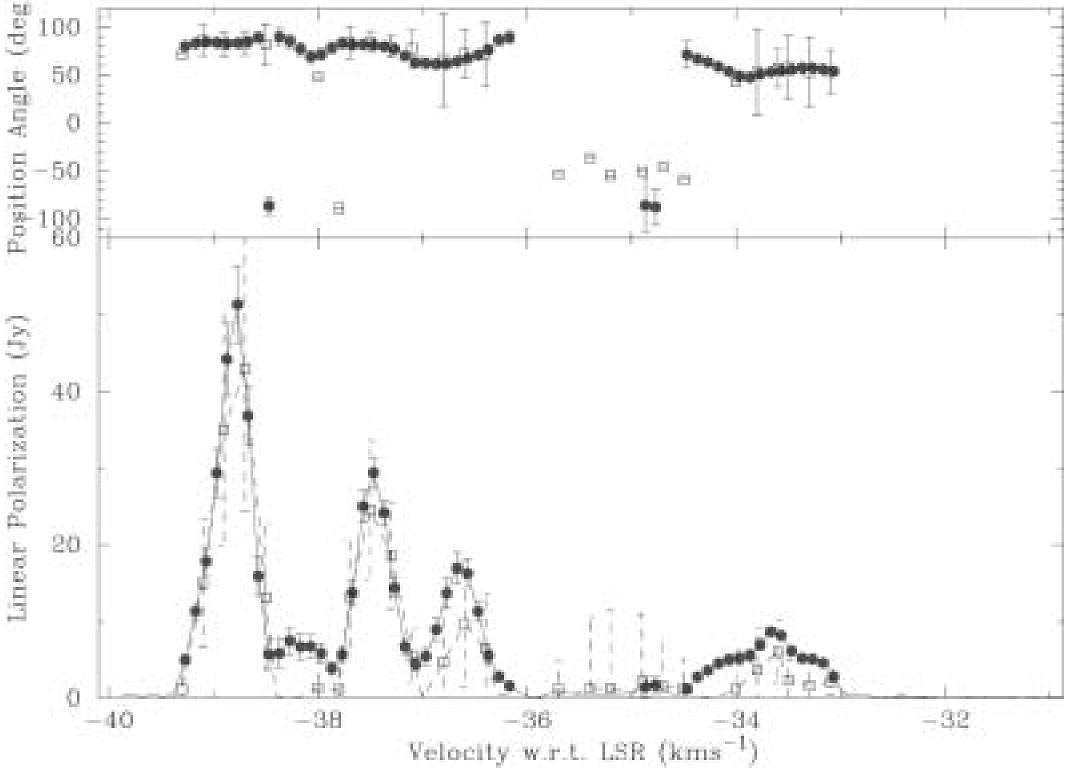

Figure 1: Polarisation angle and fraction for G339.8-1.26, as observed by the LBA (Dodson 2008, open squares), and the ATCA (Ellingsen, priv. comm., closed circles). The spectra is scalar summed across the image (Stokes I,Q and U), and shows good agreement between the VLBI and the connected array results. The errors are the absolute errors based on the confidence in the polarisation calibration (2 % and 0.4 % respectively), not the relative errors. Where errors are not shown they could not be calculated.

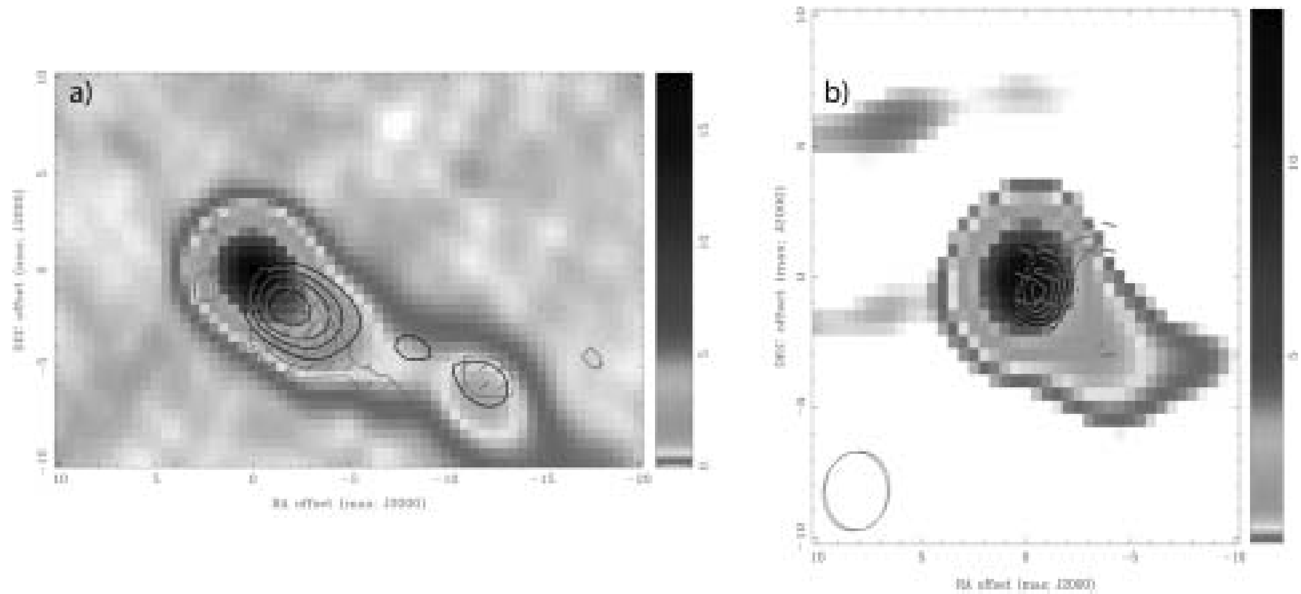

Figure 2: a) The polarised flux from 3C273, as observed by the LBA and the VLBA (smoothed) in 2008. The black contours are the VLBA polarised intensity, the grey those of the LBA with the LBA polarisation vectors overlaid. b) The polarised flux from 3C279, as observed by the LBA and the VLBA in 2008. The black contours are the VLBA polarised intensity, the grey those of the LBA with the LBA polarisation vectors overlaid.

was (at the time of the experiment) one of the best candidates to show methanol masers forming in the dusty disk surrounding a massive forming star.

Using unpublished results from Simon Ellingsen we compared the polarised flux and position angle averaged over the maser for both these LBA observations and those from ATCA (made the year before). The position angle and polarised flux by velocity channel for both the ATCA data and the LBA data are shown in Figure 1. This shows pleasing agreement between the polarised fluxes and position angles by velocity channel.

A comparison of the VLBA and the LBA has also been performed. We recently (March 2008) observed a number of sources at 8.4 GHz: 3C273, 3C279, 1921-293 and 1934-638. The first two are regularly monitored under the MOJAVE project (***Monitoring Of Jets and AGN with VLBA Experiments,*** Lister & Homan 2005). The telescopes involved were the same as before. After the smoothing of the VLBA data to the LBA resolution (~3 milli-arcseconds) we were able to compare the two datasets (see Figure 2). The total fluxes are in good agreement and the polarised fluxes and angles are in reasonable agreement. The problems which remain are related to known problems with the data, not with the procedure. Mopra, for example, had D-terms of 35% where normally we would expect D-terms to be better than 10%. The hybrid tuning, which was the source of this problem, has been rectified.

The first focus for use of these new capabilities will be to follow-up the results from G339.8-1.26, and test the prediction of the magnetic field directions from the model of methanol masers arising in disks in a significant number of sources. Furthermore, if sufficiently good calibration can be achieved, we will use the Stokes V magnitudes to estimate the field strengths and recover the full three dimensional magnetic field in these massive star forming regions. The magnetic fields are a significant influence in these regions, and have not been fully considered in current modelling. These questions can only be answered with VLBI resolution, and the LBA observations are opening up this field for investigation.

Results from polarisation imaging with the LBA of Active Galactic Nuclei (AGNs) and their jets will follow up the work done by the MOJAVE survey in the North. The polarisation of the ejection components, and their dynamic development with time and with jet position, are a delicate probe of the conditions therein.

We would encourage anyone interested to test out their own science ideas with the new capability, as the more observations made, the better we will understand the system and therefore improve the outcomes.

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REGULAR ITEMS

ATNF Operations

Jessica Chapman and David McConnell (ATNF)

By 2012 the Australia Telescope National Facility (ATNF) will be operating four world-class observatories: the Australia Telescope Compact Array (ATCA), the Parkes and Mopra radio telescopes, and the Australian SKA Pathfinder telescope (ASKAP) – currently under development. These facilities will also be operated together for very high angular resolution observations as the Long Baseline Array (LBA). Astronomers will also have access to some time on the Tidbinbilla 70-m and 34-m antennas.

Planning for future ATNF operations began in early 2007. In December 2007, a document ***Future ATNF Operations (Version 1)*** was prepared for discussion with the ATNF Steering Committee and this document was made available to the user community in February 2008. This document has now been substantially revised and version 2 was be made available around the end of October 2008. Since February 2008, much progress has been made in ATNF Operations. We would like to highlight:

Community consultation: An extensive process of seeking input and consulting with the user community on the operations plans and the ATNF science priorities has taken place during 2008. This has been extremely valuable and has had a big impact on the development of the ATNF's plans for the future.

Operations restructure: The ATNF Operations theme has now been restructured into two groups, for science and engineering operations.

Science Priorities: An essential part of the planning process has been to clearly identify the ATNF Science Priorities for the period 2010 – 2015. A discussion paper on these is now available.

ASKAP user policy: Good progress has been made towards establishing the user policies for ASKAP through the efforts of an international taskforce and a draft policy is now available.

ASKAP 12-m testbed antenna: A new 12-m testbed antenna for ASKAP has been successfully commissioned at the Parkes Observatory, with extensive input from operations staff, resulting in very promising first light tests with the new phased array feed receiver for ASKAP.

A new 12-mm receiver at Parkes: A new and far more sensitive 12-mm receiver has now been commissioned at Parkes with excellent first science results obtained in September 2008.

These have all added up to a busy and productive period, especially as all of this work has been in addition to the core daily tasks of operating ATNF's facilities and providing observing and other support to our many visitors and observers. It is a great credit to all of our operations staff that this has been possible.

Input from the community on any aspect of the operations plans, and on the science priorities, is always welcome. This should be sent either through available web forums, or by email to

Jessica.Chapman@csiro.au,

Lewis.Ball@csiro.au or

David.McConnell@csiro.au.

For all web links on ATNF operations planning, please see

www.atnf.csiro.au/observers/planning/.

ATNF Science Operations

David McConnell and Phil Edwards (ATNF)

In July 2008 the ATNF adopted a new structure for managing telescope operations and the two organisational entities, Science Operations and Engineering Operations, were established. Broadly speaking, Engineering Operations deal with the hardware (telescopes, instrumentation, infrastructure) and Science Operations deal with software and "live-ware": the users, their support, proposals, allocation to the telescopes, and the operational and data reducing software and associated computing. Science Operations includes the running of the specialised accommodation services at the observatories and the visitors' lodge at Marsfield. Science Operations is divided into four areas:

Telescope Operations and Science Services (TOSS): Coordination with Engineering Operations; Telescope calibration and systems analysis; Time Assignment Committee; usage statistics; calibration sources and catalogues; off-line data verification; user friend support (all stages); user guides and all user support; support for Target-of-Opportunity requests and queue scheduling.

Computing Infrastructure (CI): Operating systems; site-site communications (conference links etc); observers' environment (terminals etc); user and email accounts and passwords; data back ups and management; infrastructure (networks, servers, data storage); network services (email systems, authentication, etc).

Scientific Computing and Archives (SCA): Telescope control and monitoring software; data reduction, image analysis. The Australia Telescope Online Archive (ATOA); Online Proposal Application system (OPAL); scheduling software.

Visitors Services (VS): Visitor administration, accommodation bookings and invoices; Lodge services; office allocations.

ATNF users have been accustomed to Officers-in-Charge at the Parkes and Narrabri observatories being critical links and contact points for many issues related to their observations, directly while observing, and indirectly when preparing proposals or reducing data. In future, users should contact members of the TOSS group that is led by Phil Edwards. Phil will be supported, from early in 2009, by newly appointed Senior System Scientists at each of Parkes and Narrabri: Ettore Carretti and Jamie Stevens respectively.

The other groups are led by Shaun Amy (CI), Mark Wieringa (SCA) and Vicki Drazenovic (VS).

Time assignment information

Philip Edwards and Jessica Chapman (ATNF)

The 2009 APRS

For Parkes, Mopra, the LBA and Tidbinbilla the 2009 April Semester (2009 APRS) will run for a six-month period from 1 April until 30 September 2009. For the Australia Telescope Compact Array, there will be a six-week shutdown from 1 March until mid April 2009 for the installation of the full Compact Array Broadband Backend (CABB). For the Compact Array only, the 2009 APRS will run for a three-month period from 15 April 2009 until 14 July 2009.

Compact Array proposals submitted for the 2009 APRS will be considered for this period only. For this semester, CABB will be available with 2-GHz bandwidths with a single observing mode as described below. We strongly recommend that proposals for this semester include an ATNF staff member. Please note that because of the need for local knowledge in using the new CABB systems, remote observing is expected to be more restricted in this semester.

A separate call for Compact Array proposals will be announced on 15 April 2009, with a deadline of 15 May 2009 for a "2009 JULS" semester. The 2009 JULS will run from 15 July 2009 until the end of September 2009. Compact Array proposals not scheduled in the 2009 APRS should be resubmitted for consideration in the 2009 JULS. It is expected that one or more CABB zoom modes will be available for this semester.

Compact Array Broadband Backend

During the six-week shutdown of the ATCA the existing array backend and correlator will be permanently removed to allow for the installation of the full CABB system on all six antennas.

2009 APRS will be the first semester to offer the CABB capability. For 2009 APRS, CABB will be available with a single coarse resolution mode with a bandwidth of 2 GHz and a spectral resolution of 1 MHz, corresponding to 2048 spectral channels.

In the 12-, 7- and 3-mm bands, two frequencies may be selected: the spacing between the two frequencies may be larger than the current limit of 2.7 GHz, but must be less than 6 GHz and will depend on the observing frequencies chosen. Observing will be possible with the standard 12-mm (16 – 25 GHz) and 7-mm (30 – 50 GHz) systems on all six antennas, and 3-mm systems (83.5 – 105.0 GHz) on five antennas. Observers planning 3-mm observations in an extended array (H214 or EW352) are encouraged to consider also requesting time in more compact configurations as many 3-mm sources are weak and extended and the longer baselines may not detect all of the emission.

In the 6- and 3-cm bands the existing front-ends allow a 2-GHz bandwidth to be used, with 4.5 to 6.5 GHz and 8.0 to 10.0 GHz being the nominal ranges. Simultaneous 6/3-cm observing will continue to be possible. In the 20- and 13-cm bands the usable bandwidth is limited by the front-ends to around 500 MHz, though radio frequency interference (RFI) will reduce the usable bandwidth, particularly at 20 cm. Simultaneous observations at 20/13 cm will not be possible.

Proposers are reminded that the primary flux density calibrator at 7 mm and 3 mm is Uranus, which for 2009 APRS will be at a Right Ascension of 23 h 45 m and declination of -2 d 30 m. Observatory staff will calibrate a number of bright active galactic nuclei (AGN) spread over the full range of right ascensions, against Uranus at the standard continuum observing frequencies throughout the semester for use as secondary flux density calibrators if Uranus is not visible, or is resolved out. Proposers requiring their own observations of Uranus (at special frequencies, for example), should make this clear in the justification of their proposal.

Proposers for multi-source observations are reminded that it is extremely useful for the justification to include a clear statement about how the observations can be optimally scheduled. A statement along the lines of "six blocks of ten hours duration scheduled anywhere between 4:00 and 16:00 LST" both indicates to the Time Assignmnent Committee (TAC) that you have carefully thought about the scheduling of your proposed observation, and makes the scheduling of the observations much easier.

Support for Tidbinbilla observations

Access to antennas at the Canberra Deep Space Communications Complex (CDSCC) at Tidbinbilla is provided under the Host Country agreement with NASA and made available to the astronomical community though the ATNF. The 70-m antenna provides the most sensitive system in the southern hemisphere for this band, with a system temperature of 60 Jy. Tidbinbilla has been used with considerable success for sensitive single-dish observations using the 70-m antenna in the 12-mm band. The new 12-mm receiver at Parkes has a sensitivity three times that of its predecessor but Tidbinbilla remains the most sensitive southern hemisphere antenna for this band.

Tidbinbilla single-dish observations are taken in a service observing mode with typically 200 hours of observing time available in a year. The level of support to be provided by the ATNF for single dish spectroscopy at Tidbinbilla has been uncertain until recently. An arrangement has now been set up in which service observations will be taken by the CDSCC Radio Astronomy Engineer, Shinji Horiuchi, while the ATNF will provide in-kind support. This will include announcements of opportunity and time allocation processes, the maintenance of Tidbinbilla-related web information and engineering support for specialised ATNF equipment. Jimi Green, from the ATNF, will liaise with and provide advice to Shinji in his role of astronomy support and is now the ATNF point of contact for Tidbinbilla enquiries.

For enquiries relating to single dish observations with Tidbinbilla, please contact Jimi Green ***(Jimi.Green@csiro.au).***

ATNF Engineering Operations

Brett Dawson (ATNF)

July 2008 saw the introduction of a new operational structure for the ATNF. The Engineering and Science Operations groups were formed to run the National Facility instruments. These changes have in part been made to facilitate the transition to ASKAP operations and to consolidate operations in ways which reduce duplication of functions across sites and aim to more efficiently run our facilities.

Parkes and Narrabri now each have a Site Manager and Technical Coordinator. In addition, four technical project groups were formed across the Parkes and Narrabri operations groups. Site Manager and Technical Coordinator for Narrabri and Mopra is Brett Hiscock. At Parkes the Site Manager is Brett Dawson and the Technical Coordinator is Brett Preisig.

At each facility Site Managers have overall responsibility for continuity of operations. Technical coordinators have a specific role related to instrument configuration and fault rectification.

Project leaders are responsible for the planning and delivery of projects in their respective areas. The new project groups are Mechanical, Drives and Electrical (MDE project leader is Tim Wilson), Digital, Servo and Electronics (DSE project leader is Peter Mirtschin), Receivers, LO and Conversion (RLOC project leader is Jock McFee) and Cryogenics (CRYO project leader is John Wilson)

2009 will see Engineering Operations become substantially more project driven. In particular, projects which support the automation and remote operation of Parkes, and preparations for the establishment of a Science Operations Centre in Sydney, will continue to be high priorities for Engineering Operations.

ATNF publications list

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

This list includes published refereed papers compiled since the April 2008 newsletter. Papers which include ATNF staff are indicated by an asterisk.

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ATNF outreach

ATNF teacher workshops

Rob Hollow (ATNF)

Two teacher workshops were run by ATNF in the first half of 2008. ***Astrophysics for Physics Teachers*** was a one-day workshop at Marsfield in April. Participants heard talks about stellar evolution and explored useful classroom activities. A highlight of the workshop was the first ***Live from Gemini*** video conference session in which Gemini Outreach Scientist, Dr Scott Fisher, discussed modern optical/infra-red (IR) observing with the teachers from the Gemini control room at Hilo in Hawaii.

The annual three-day ***Astronomy from the Ground Up!*** workshop was a great success at Parkes in May. Clear skies allowed for plenty of viewing at night to complement the varied range of daytime talks and practical sessions.

ATNF has expanded its collaboration with other organisations to offer teacher professional development around Australia. Workshops were held at the SPICE Centre at the University of Western Australia, the Victorian Space Science Education Centre and at the University of Southern Queensland at Toowoomba through the support of the Queensland Department of Education, Training and the Arts. Workshops were also held in regional Western Australia (WA) in Geraldton and Kalgoorlie in conjunction with Astronomy WA. Workshop sessions were also held at several Science Teacher state and national conferences including CONASTA at the Gold Coast in July.

ASKAP outreach

Rob Hollow (ATNF)

Mary Mulcahy and Rob Hollow visited Pia Wadjarri Remote Community School, near Boolardy in WA, in October for an activity-filled day of astronomy. They were accompanied by Professor Steven Tingay and Dr Megan Argo from Curtin University. The Pia students were joined once again by those from Yalgoo Primary School who came up for an overnight excursion. Daytime activities included size and scale of the Solar System, constellations and sky pattern plus balloon and water rockets. Unfortunately a cloudy night prevented the students from looking through the telescopes at the night sky but hopefully the next visit will be clearer. Whilst in Geraldton we briefed local teachers and other interested parties about the Australian Square Kilometre Array Pathfinder (ASKAP) and educational opportunities.

Art meets science at telescope open day

Helen Sim (ATNF)

CSIRO's Australia Telescope Compact Array marked its twentieth birthday on Saturday 19 July 2008 with an open day that drew more than five hundred visitors. The radio telescope, near Narrabri NSW, is opened to the public only once every two years.

Visitors were given guided tours of the antennas, quizzed astronomers in the control room, heard talks on different aspects of astronomy, and yarned with staff about the cosmos.

In the two weeks leading up to the open day the Compact Array hosted an Artist-in-Residence, award winning artist Christine Hill.

During the residency Christine painted pictures of people and daily life at the observatory, held workshops for school children who painted their interpretations of space, and culminated the residency at the open day with an exhibition and interactive public activities.

Above and top right: Teacher and students enjoying the astronomy day activities at Pia Wadjarri Remote Community School, assisted by Megan Argo (Curtin University of Technology), Mary Mulcahy (ATNF) and Steven Tingay (Curtin University of Technology) respectively.

Right: Participants from the annual *Astronomy from the Ground Up!* workshop held at Parkes in May get to experience the dish close-up.

Photos: Robert Hollow, CSIRO

Bottom right: Narrabri Artist-in-Residence Christine Hill with children and their artworks.

Photo: Joanne Houldsworth, CSIRO

Below: Vicki Fraser (ATNF) greeting visitors at the Compact Array open day.

Photo: Phil Crosby, CSIRO

Dr Phil Edwards preparing to light the candles on the 20th birthday cake at the ATNF Compact Array Open Day held in July 2008 at Narrabri. An eager crowd of children looks on.

Photo: Phil Crosby, CSIRO

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