ATNF News

Issue No. 54, October 2004
ISSN 1323-6326

FEATURES IN THIS ISSUE

They're here

Five antennas of the Compact Array are now outfitted with 3-mm systems operating at 85 – 105 GHz. First fringes were obtained at 7:10 pm on 20 September. They marked the culmination of the Compact Array's high-frequency upgrade, largely funded by the first round of the Commonwealth government's Major National Research Facilities program. Previous newsletters have featured developments in the saga. As those who've been following them will know, the upgrade has involved change on many fronts:

- construction of six new receiver packages incorporating the broadband 3- and 12-mm systems (and provision for a future 7-mm system);
- a new fibre-based reference distribution system for the local oscillators;
- the design of LO multiplier chains for the 3- and 12-mm receivers;
- new ATNF-designed helium scroll compressors;
- new antenna panels, and re-adjustment of the antenna surfaces;
- construction of an atmospheric seeing monitor;
- new antenna control computers; and
- the building of the north-spur and additional stations.

Not to mention blood, sweat, toil and tears.

The promise of the 3-mm system attracted 50% more Compact Array proposals than usual for the 2004 MAY term. Less than four hours after the first fringes hit the screen, the first scheduled observations began. Fifteen projects involving 3-mm observations were carried out between 20 September and mid-October, when the observing season ended. Elaine Sadler (University of Sydney) was a member of the team for one of the earliest projects – an ambitious attempt to detect CO at a redshift of five. "I was just amazed at how well [the system] worked," she said. Having the capacity to observe at both 12-mm and 3-mm wavelengths is extremely useful, Sadler said. "For galaxies at a redshift of four, you can observe the CO (1-0) transition at 12 mm and the (5-4) transition in the 3-mm band. These complementary tools give you a more complete picture of the physical condition of the gas at the time these galaxies are having their first big burst of star formation." James Urquhart (University of Leeds) had two

Continued on page 17

Photo: David Smyth

Figure 1: Peter Mirtschin (ATNF, Narrabri) admires the newly installed 3-mm system.

Editorial

Welcome to the October 2004 ATNF newsletter.

Our cover article presents a major milestone at the Compact Array with the successful installation of new millimeter receivers on five antennas of the array. We present one of the first science results from this exciting new facility. The unraveling of the puzzling Class-I methanol masers making use of the high resolution enabled by the Compact Array is described on page 18.

Our two science articles reflect the growing popularity of the 12-mm system at the Compact Array. On page 14, Juergen Ott discusses the mapping of different molecular gas species (in particular ammonia in nearby starburst galaxies) leading to measurement of their physical parameters. The 12-mm system also allows mapping of quasar jets in exquisite detail – a project described by Jim Lovell on page 19.

Public outreach continues to have a high priority at the ATNF as can be seen from the outreach items in this issue. Developments at the observatories can be found in the observatory reports. A new mapping mode implemented at Mopra is reported on page 8. The time assignment information on page 29 provides useful information for prospective observers following the installation of the mm systems and attendant constraints.

We hope you enjoy this issue. We thank all our contributors for their support. Your comments and suggestions are always welcome. You can get in touch with us at *newsletter@atnf.csiro.au*.

A special thanks to Vicki Drazenovic for standing in for Joanne Houldsworth for this issue. Our best wishes to Joanne while she is on leave.

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

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From the Director

In this newsletter, we celebrate the commissioning of the 3-mm system at the Compact Array. This marks the culmination of seven years' effort at the ATNF and is a tribute to the skill and dedication of the technicians, engineers and scientists who worked on the project. It is in the nature of these leading-edge endeavours that initial time scales are subject to significant uncertainty due to the technology risks knowingly undertaken. The major delay in commissioning the 3-mm system was, in a large part, due to the need to develop the MMIC-based receiver technology in-house. Nevertheless, the development of this engineering capability is now of crucial importance for SKA-related work.

The ATNF also acknowledges the community's support in their response to the final slippage in the commissioning time scale, which required significant re-scheduling of existing runs and the loss of a few programs to use the 3- and 12-mm systems.

Despite the delays, the high demand for the system and the potential science impact of the early programs underscores the importance of upgrading the Compact Array to mm-wave astronomy. Strategically, the Compact Array now provides a mm-wave capability in the Southern Hemisphere that can be used in part as a pathfinder for ALMA science, providing important complementary and/or support observations in the pre-ALMA period over the next five years.

Given this window of opportunity, it is important that everything is done to maximise the efficiency of the mm-wave observations over the coming years. Observing in this domain brings new challenges, particularly the far greater dependency on atmospheric conditions. The ATNF will be reviewing how best to optimise the scheduling of 3-mm observations in coming semesters, both by gaining a better knowledge of the atmospheric conditions and by reviewing flexible scheduling options, including the existing swap-time program. Furthermore, the move towards remote operation of Mopra is an additional strategy in maximising the science outcomes for mm-wave astronomy at the ATNF.

In the near future, we can look forward to adding further mm-wave capability at the ATNF via the commissioning of the new Mopra 3-mm receiver, with extended frequency coverage above 105 GHz, and the MOPS broadband (8 GHz) filterbank. By the same token as above, both these developments are not without their associated outstanding engineering risks. Consequently no hard and fast guarantees can be given at this stage about their availability at the start of the next mm-wave observing season. However, the strategic importance of both completing the upgrade of the ATNF's mm-wave capability and development of the digital filterbank technology for the SKA-related MNRF Compact Array Broadband Backend (CABB) project means that this program will have the highest priority over the coming months.

Brian Boyle
(Brian.Boyle@csiro.au)

ATNF graduate student program

It's a pleasure to introduce four new students who have recently started PhD projects with ATNF co-supervisors:

- Deanna Matthews (La Trobe University) has started a project "High Velocity Clouds around the Galaxy" with Prof Peter Dyson (La Trobe) and Dr Lister Staveley-Smith (ATNF).
- Katherine Newton-McGee (University of Sydney) has started her project "The Magnetic Universe" with A/Prof Anne Green (University of Sydney), Drs Ron Ekers and Naomi McClure-Griffiths (ATNF).
- Ivy Wong (University of Melbourne) has started a project "Neutral Hydrogen in a Galaxy Cluster Environment" with a supervisory panel consisting of Prof Rachel Webster (Melbourne), Dr Lister Staveley-Smith (ATNF), Dr Virginia Kilborn (Swinburne) and Dr Gerhardt Meurer (Johns Hopkins University).
- XiaoPeng You (National Astronomical Observatories of China, Chinese Academy of Sciences) has started a project "Pulsar Timing Studies" with Dr J.L. Han (NAOC) and Dr Dick Manchester (ATNF).

We also congratulate Erik Muller on the successful defence of his PhD thesis, "High resolution studies of the HI in the Western Magellanic Bridge"; Catherine Buchanan (previously Drake) on her successful PhD thesis, "Radio-Excess IRAS Galaxies"; and Gianni Bernardi on the successful submission of his PhD thesis, "Diffuse Galactic polarised synchrotron radiation as foreground for CMBP experiments". Erik has been a postdoctoral fellow at Arecibo Observatory since mid-2003; Catherine is now at Rochester Institute of Technology, USA and Gianni is at the University of Bologna.

Lister Staveley-Smith
Graduate Student Coordinator
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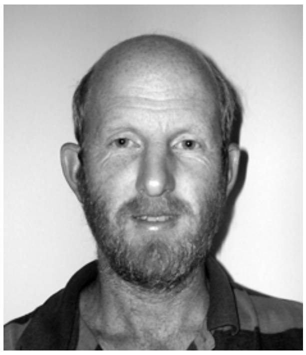
Senior research astronomer – Simon Johnston

The ATNF is delighted to announce that the position of Senior Research Astronomer, advertised earlier this year, has been accepted by Simon Johnston, formerly of the University of Sydney.

Simon obtained his PhD from Jodrell Bank in 1990. His thesis involved surveying the southern Galactic plane for pulsars and he spent substantial time in Australia during that period. In 1989 he discovered his favourite object, PSR B1259-63, a pulsar in a highly eccentric, long period orbit with a Be star companion. Its unique characteristics have kept him busy trying to understand its mysteries for the last 15 years. Having become used to the sun and beach lifestyle, in 1991 he accepted a two-year postdoctoral fellowship at the ATNF to work with Dick Manchester on a further, highly successful pulsar survey. In 1993 he moved to the University of Sydney where for five years he was part of the Research Centre for Theoretical Astrophysics headed by Don Melrose. Shortly afterwards he started a collaboration with Baerbel Koribalski which not only produced HI absorption measurements towards pulsars but also the birth of their son Christopher in 1998. Also in 1998 he obtained a QEII Fellowship from the ARC to study the polarisation properties of single pulses from pulsars. In late 2003 he was awarded a Professorial Fellowship to work on aspects of pulsar timing and the detection of gravity waves.



Dr Simon Johnston, senior research astronomer, ATNF

Simon joins the ATNF in early November 2004. He will continue his research into radio pulsars and will take on the role of Project Scientist for the New Technology Demonstrator.

Lister Staveley-Smith
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Distinguished visitor program

In the past few months, we have had the pleasure of the company of Yi-nan Chin (Tamkang University, Taiwan), Francois Viallefond (Observatoire de Paris), Phil Edwards (ISAS, Japan), Trish Henning (UNM, New Mexico), Rick Jenet (JPL), and Tim Cornwell (NRAO).

Currently, we have Joel Weisberg (Carleton College, USA, visiting until June 2005), Renee Kraan-Korteweg (University of Guanajuato, Mexico, visiting until December) and Eric Wilcots (University of Wisconsin-Madison, USA, visiting until December).
In the very near future, we look forward to a visit from Christian Henkel (MPIfR, Germany) who will visit during the month of November.

Prospective visitors should discuss working visits with the Director, a staff collaborator or myself.

Lister Staveley-Smith, on behalf of the DV committee
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ATNF divisional awards

Each year, work of merit and excellence within CSIRO is recognised through Divisional Awards, CSIRO Awards and CSIRO Medals. Awards are typically merited in only a subset of the range of categories considered. This year's ATNF Divisional Awards recognising exceptional achievements were recently announced by the Director, Professor Brian Boyle. The winners go on to become candidates for CSIRO Awards when there is a corresponding category.

Two groups of staff received ATNF Divisional Awards in 2004, one in the "Partner or Perish" and another in the "Go for Growth" categories.

The Partner or Perish award recognises the efforts of the entire staff of the Parkes Observatory in ensuring the outstanding success of the Mars tracking contract between the ATNF and NASA. Partner or Perish awards are for projects that have a long term benefit to CSIRO through the development of a strategic alliance with another R&D provider. The Parkes Observatory staff were recognised for their "cohesive teamwork, commitment and adaptability" that has played a significant role in ensuring that the strategic alliance between the ATNF and NASA will continue.

The Arecibo Multibeam Team, represented by the project manager Graeme Carrad, received the Go for Growth Award for the successful completion of the Arecibo Multibeam receiver, built by the ATNF receiver group under contract to the National Astronomy and Ionosphere Center, Cornell University. Go for Growth awards recognise achievements that open national or international markets in which CSIRO previously had a minimal presence. The Award to the Arecibo Multibeam Team recognised the success of this project "of international significance ... [which] opens up the world market for ATNF built receivers and other innovative technical equipment ...[and] confirms the ATNF as the major world player in supplying such equipment to the world radio astronomy community".

Two ATNF Divisional awards were made to individual staff, one for "Leadership" and the other for a "Lifetime Contribution".

Dr John Reynolds received a Leadership Award for "Outstanding leadership as Parkes Officer-in-Charge since 1998", acknowledging his "success in forging a committed and tremendously effective team [which] routinely ensures that the Parkes Telescope operates as a world-class facility".

Dr Dick Manchester received a Lifetime Contribution award for his "Outstanding contributions to pulsar research". Dick's award acknowledges an "outstanding career of over 35 years beginning with the discovery of the first pulsar glitch, spanning a series of large-scale surveys which have made the Parkes radio telescope the pre-eminent instrument in the world for the discovery of pulsars, recently crowned by the first ever detection of a double-pulsar system".

The ATNF Divisional awards were celebrated at a number of social functions and recipients were presented with a small memento. The Parkes Observatory Staff and the Arecibo Multibeam Team have been nominated for CSIRO awards in the Partnership Excellence and Go for Growth categories respectively.

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Farewell to Barry Parsons

10 September this year saw the retirement of Barry Parsons as Senior Mechanical Engineer. Over the last 24 years Barry made an invaluable contribution to the Radiophysics Laboratory and the ATNF in particular working on a wide range of projects, from the Interscan Aircraft Landing System in the 1970s, to work on the design and construction of the Compact Array. He will always be remembered as the expert in surface panel technology.

A farewell barbecue was held at Marsfield where many of his colleagues past and present attended to thank him for his friendship over the years and wish him all the very best for the future.

Phil Sharp
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Photo: Helen Sim

Brian Wilcockson (right) presents Barry with a memento of his working life at the ATNF

Workshop on the broadband backend project for the Compact Array

A workshop was held at the ATNF headquarters in Marsfield on 13 September 2004, to discuss the technical specification of the planned broadband backend for the Compact Array, as well as its scientific capabilities. The Compact Array Broadband Backend (CABB) will be the correlator that replaces the current correlator and is aimed at providing: an increase in the Compact Array continuum sensitivity of up to a factor of four (due to a maximum bandwidth of 2 GHz at each of 2 IFs in 2 polarisations), greatly enhanced spectral-line performance, connections to additional antennas (such as the New Technology Demonstrator), and new correlator technologies for Square Kilometre Array (SKA) demonstrations. The CABB project is funded by the Major National Research Facilities Program (see ATNF Newsletter #45).

The workshop was organised by the Australia Telescope Users Committee (ATUC) and the CABB project scientist, Jim Caswell, and was an opportunity for the CABB project to present the base technical specifications of the new correlator to the user community. The CABB project manager, Warwick Wilson did exactly this during an interesting talk. The CABB will be an ‘FX’ style correlator, in contrast to the current ‘XF’ Compact Array correlator, and will use digital filter banks to allow very flexible choices of observing bandwidths and numbers of frequency channels.

A series of talks were then aimed at describing some of the scientific applications of the new correlator. Of note is the proposal that the CABB be eventually used as a real-time correlator for Australian VLBI, once high speed optical fibre connections are installed between all Australian telescopes. Also of note was the interest in using the CABB for frequencies from 1 – 10 GHz. Initially the CABB will be of most utility at 1 cm and 3 mm, where contiguous frequency bands of greater than 2 GHz are available. The Compact Array and CABB will allow important short term scientific gains to be made at these frequencies. The use of the CABB in the 1 – 10 GHz range will need to wait until the Compact Array front-end electronics can be modified to give broad bands.

The presentations given at the workshop are available on the ATNF meetings archive. The discussion from the meeting will be used to refine the technical specifications for the CABB, which will be presented to ATUC meetings over the next 12 months. For further information on the CABB, please contact Jim Caswell, CABB project scientist.

Steven Tingay
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Australia Telescope Online Archive

The Australia Telescope Online Archive (ATOA) is an online data store that contains the raw (uncalibrated) data files from Compact Array observations taken since 1990. These data are stored in a large number of files in RPFITS format, with approximately two terabytes of data in total. Currently, copies of the archive files are provided on request, by manually copying the files onto CDs that are then sent by post.

To facilitate and encourage greater use of the archive files, the ATNF and the ICT Centre in Canberra have developed a new system that will replace the manual handling of archive data and allow users to directly access the data files via an easy-to-use web interface. To facilitate the querying of the data files, Robin Wark (ATNF), Dr Peter Lamb, Robert Power and colleagues (ICT Centre) transferred the archive to disk and developed software to construct metadata derived from the file headers. This and other related information are stored in an Oracle database. The data archive and software are now being transferred from Canberra to the ATNF site in Marsfield. The web-interface to support the querying and downloading of data has recently been developed by the ATNF webmaster (Christopher Owen). We plan to release the ATOA in November 2004.

Data access conditions

We advise users that to make the archive data more accessible (in line with other archive facilities) and to facilitate the automatic handling of archive requests, the ATNF has introduced a change in the data access conditions. For standard data files the data access conditions now state that:

"data obtained from the ATNF facilities will be made available to other users on request 18 months *after the observation date*, unless a special case for extended proprietary rights is accepted by the Director or Time Allocation Committee. The ATNF Director may override the release of data at his discretion."

This replaces the previous data access conditions where data were made available on request 18 months *after the end of observations.*

The ATOA will also allow observers to access their own data taken during the previous 18 months. In this case the data access will be provided via a project-based password that will be issued to the project principal investigator.

For further information please contact Jessica Chapman.

Jessica Chapman
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CSIRO information technology support changes

We advise visitors to the ATNF and users of our facilities that computing support arrangements within CSIRO are changing. The main changes that will be evident to visitors are in making requests for computing help at the Marsfield site in Sydney, and in how visitors interact with the local support-staff at Marsfield. At the observatories, the role of the local support-people has not changed.

Previously, requests for help were made by email and from time to time by phone. There is now a new centralised (across all of CSIRO) Enterprise Service Desk *(servicedesk@csiro.au)* that is used for IT support requests. Mail sent to the old "helpdesk" address is automatically forwarded to the new address. Telephone assistance is available at the numbers 96 666 (internal phone) or 02 6276 6666 (external phone). The Service Desk will coordinate resources to resolve requests for help.

CSIRO IT

The background to these changes is that CSIRO has initiated a project to change the way in which IT support is delivered. Previously, ATNF's IT support was provided by a combination of the Computer Services Group (CSG, run by the CTIP division) and a corporate group in Canberra (ITS). There is now a new entity called "CSIRO IT" which holds the majority of IT resources in CSIRO. The former entities ITS and CSG are now part of CSIRO IT. It is planned that IT support will be consolidated

CSIRO-wide enabling CSIRO to deliver better IT support so that more resources can be focussed on science.

CSIRO IT is not responsible for all IT-related activity in CSIRO. For example, research into new Information Technologies is still directed by individual scientists and engineers. There are also substantial grey areas between basic infrastructure support and scientific research, where support is needed from people knowledgeable in both the field of research and in setting up IT infrastructure. The boundaries will be worked out over time. No ATNF staff were transferred to CSIRO IT, as we had already outsourced the infrastructure work to CSG and ATNF IT staff also have other operational roles.

The new IT support structure has three tiers. The first tier is the Enterprise Service Desk which deals with the initial call and may be able to fix the problem. If they can't, they will pass it on to either a Business Support Team or to a Technical Specialist Team. The former CSG IT staff at Marsfield are still on site, but are now in a mixture of Business Support Teams and Technical Specialist Teams. With time, IT staff may slowly move around the organisation and into new roles.

The transition to CSIRO IT is first being applied in a pilot program which covers the Sydney basin region and Newcastle. This includes the ATNF Marsfield site. The pilot is scheduled to run for three months (until about the end of October) when other parts of CSIRO will be brought into the new structure.

This is a complex change process and it will take some time to accommodate all of the changes and make it fully effective. If you are visiting the ATNF in the near future, please be aware of these changes taking place. When making a request, note that the person you interact with on the Service Desk will not be located at Marsfield. This means you will need to indicate where you are and whether you are a visitor or not. It is a good idea to include a telephone number where you can be reached.

We welcome any constructive feedback that you might have on the new IT support arrangements.

Neil Killeen, Vince McIntyre

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"On-the-fly" mapping with the Mopra telescope

We have recently implemented an On-the-fly (OTF) observing mode at Mopra to permit more efficient mapping of large regions in molecular lines. In this mode, the telescope takes data continuously while scanning across the sky and accurate coordinate information is written into the datafile with each spectrum. Not only does OTF mapping help to smooth out systematic errors as in pointing, but it also provides a net gain in efficiency because a single reference spectrum can be applied to multiple source spectra, as the effective on-source integration time is very short.

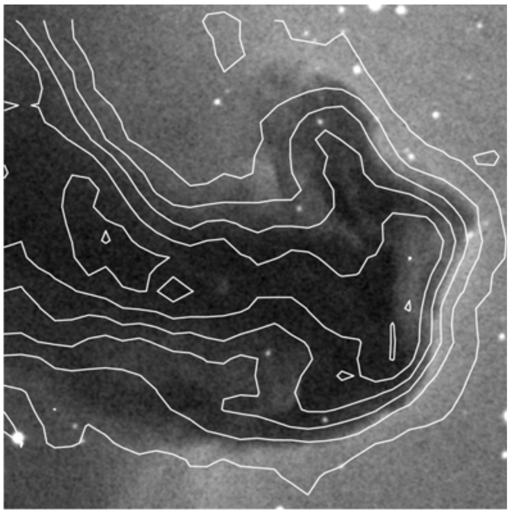

Figure 1: 6 arcmin square map of the Horsehead Nebula in ^{13}CO, overlaid on an optical image. The image has been rotated so that east is up.

The OTF mode has been made possible by several recent developments: (1) adjustment of the surface panels and subreflector to produce a more symmetric beam pattern at 3 mm, (2) installation of a new antenna control computer (ACC) that can handle shorter cycle-times, and (3) development of software to facilitate rapid scanning, schedule file preparation and processing of OTF data into spectral cubes.

The first development was needed to correct a significant coma lobe which had been a long-standing problem with the Mopra beam. After re-alignment of the optics, a significant improvement in the main-beam efficiency was noted, and the overall beam-shape could be much better approximated as Gaussian. Further discussion of the Mopra beam shape and size, as well as measured beam efficiencies and standard spectra, can be found in a recent paper submitted to PASA by Ladd et al. A copy can be downloaded from the Mopra website (*www.narrabri.atnf.csiro.au/mopra/*).

The second development, installation of a new Compact Array-style antenna control computer, has allowed us to shorten the default cycle-time from ten to two seconds, which in turn allows us to scan much faster across the sky. This has also cut down significantly on overheads, including time spent making system temperature measurements and time lost due to the "missing cycle" problem (having to request one more cycle than is actually recorded).

Last but not least, a significant amount of software development has occurred, based in large part on the Livedata and Gridzilla packages used to process Parkes Multibeam data in aips++. Livedata has been upgraded to recognise Mopra RPFITS files automatically, identify reference scans, and extract the proper coordinate information for each spectrum. It then takes care of bandpass calibration and baseline fitting and writes the spectra out to an SDFITS file. Gridzilla can take one or more SDFITS files and generate a FITS data cube based on the user's choice of coordinate frames, projections, gridding techniques and pixel size. A number of widely available visualisation tasks can be used subsequently to examine the data.

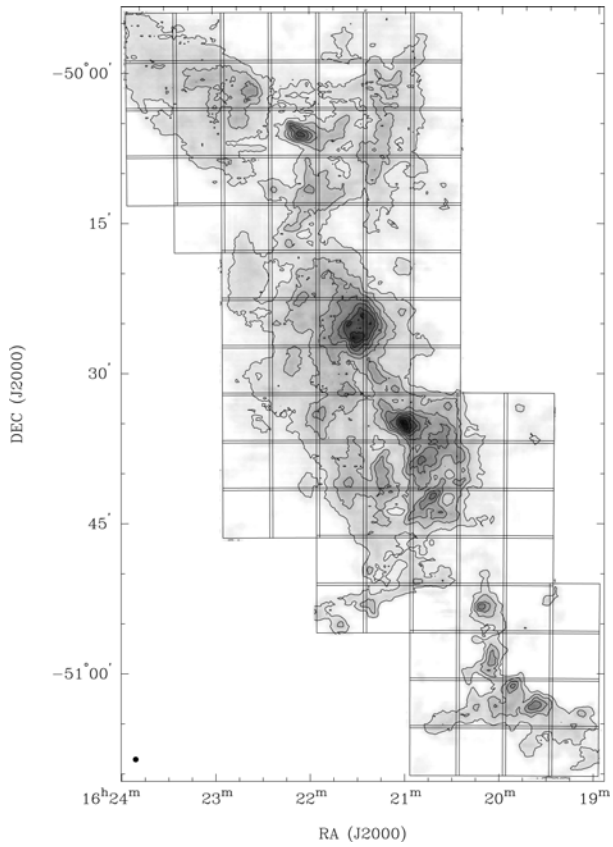

Figure 2: Mosaic of 94 fields (each 5 arcmin square) observed as part of the Delta Quadrant Survey in ^{13}CO. The black dot in the lower left is the size of Mopra's beam. Credit: UNSW Star Formation group.

Some results from this season are shown in the accompanying figures. Figure 1 shows a ^{13}CO integrated intensity map of the Horsehead Nebula overlaid on the well-known optical image. The dust extinction that is apparent in the optical image is beautifully traced by the molecular-line emission. Figure 2 shows the current state of the most ambitious OTF project undertaken thus far, ^{13}CO mapping of a 1.2° × 0.6° field in the southern Galactic plane near Galactic coordinates (333.3, -0.3). This UNSW project, called the Delta Quadrant Survey, is focused on understanding the interplay between massive star formation and the molecular interstellar gas and will be followed up with mapping in higher density molecular tracers next year.

OTF mapping is suitable for many applications, and is the preferred observing mode for almost any type of mapping at Mopra. If one oversamples the 35-arcsec primary beam for high-fidelity imaging, a sensitivity of about 0.75 K (main-beam temperature) can be obtained over a 5-arcmin square region in about 80 minutes (this yields about 1500 spectra). For larger fields the telescope can be made to scan faster (at the expense of sensitivity and oversampling) or a number of smaller fields stitched together using Gridzilla. For better sensitivity a field can be repeated several times. Note that you should not observe for more than two hours without stopping to refine the pointing. In order to make best use of OTF mapping, we suggest that users spend a few days in Marsfield after observing to work on their data with local experts. Documentation on how to conduct OTF mapping will appear on the Mopra website (*www.narrabri.atnf.csiro.au/mopra*) about a month before the next proposal deadline of 1 December.

We thank Ned Ladd for helping to develop the OTF strategy, Ravi Subrahmanyan for directing the effort to improve the beam shape, and Stuart Robertson and Cormac Purcell for helping to test and debug the technique.

Tony Wong (University of New South Wales/ATNF), Michael Kesteven (ATNF and, Mark Calabretta (ATNF)

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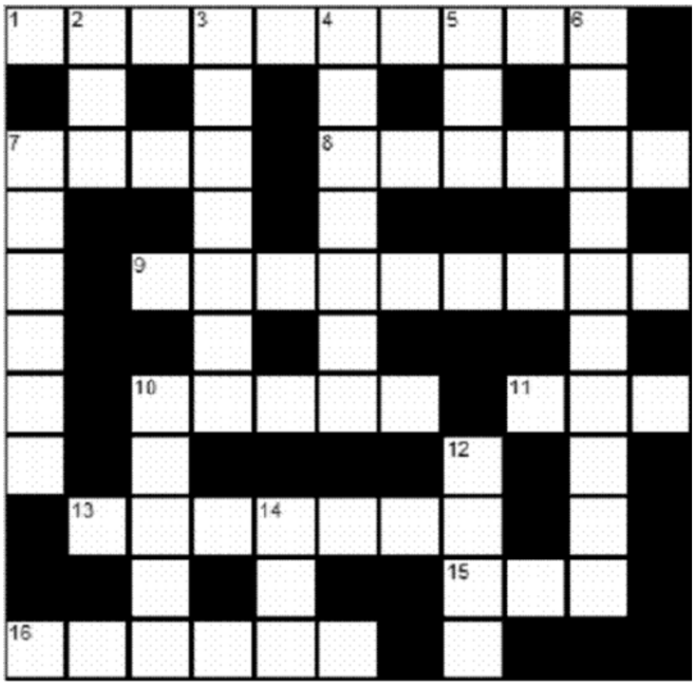
ATNF News crossword

Cryptic clues



Across

1. Newspaper opinion has princess replaced by queen’s top two and a middle earth
7. Sounds like you should know the Halley home cloud
8. Greek letter in musical note length is a let down in Sol’s cycle
9. Runner up after only a part of the circular course to a small degree
10. Those who look over things risk losing a rate to be employers
11. Front runners do sometimes negate NASAs probes into missionary positions
13. Laps up a confused observatory
15. Question letter replacing myself when gliding on snow. Overhead!
16. Spains south with very incomplete end yields broad observation

Down

2. Queerly shaped object initially looks like exotic source
3. Red giant has doubts re satan integrity
4. Surprise mother with the vice taken from tennis starter to be interesting at 1667 MHz
5. Last four editions lose their curl to become a charged particle
6. Limousine without its rear bumper in a prang gets a heartless toy to finish and have brightness
7. Tardy outside broadcast flips the Red Spot’s planet’s spheroidal shape
10. After dinner meal first loser in higher reaches
12. Hakim assassination has the right inertial stuff
14. Body of water we hear is good looking

Quick clues

Across

1. 0 deg latitude area
7. Cloud where comets start
8. Low point in sunspot cycle
9. Measure of angle
10. Those who observe
11. NASAs system for talking with probes (abbr)
13. Northern hemisphere observatory
15. What’s up
16. Wide search for objects

Down

2. Early name for quasar (abbr)
3. Brightest star in Taurus
4. 1667 MHz source
5. Charged particle
6. Measure of brightness
7. Spheroidal shape of Jupiter
10. Higher section
12. You can have lots of this but weigh nothing in zero gravity
14. Clear, dry skies are good for —ing

Graeme Carrad, ATNF
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Brian John Robinson: 1930 – 2004

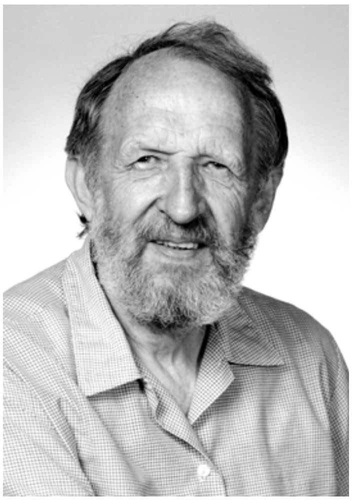
Former ATNF staff member Brian Robinson died peacefully in his sleep on 22 July 2004. He was 73.

Brian was born on 4 November 1930 in Melbourne, where his father, Ray Robinson, was a journalist with the Melbourne Herald. When he was eight, the family moved to Sydney. "I went to Waverley School on the edge of Paddington, then a slum and notorious for the razor and acid gangs," Brian recalled. "As a kid from Melbourne I was treated just like the refugee kids arriving from Europe. I wore glasses and got beaten up every day but I made some great friends among the European Jewish kids."[1]

Brian's father was a libertarian and would take his son along to parties of the Sydney Push, a group of bohemian writers, artists, musicians and academics. These were often held at the home of journalist Cyril Pearl near the Figtree Bridge. Here, Brian recalls, he witnessed some rather 'adult' behaviour, but "but at my age [I] was actually keener to …take Cyril's canoe out on the river and explore". When the family later moved to Lane Cove, "I lived a kind of Huck Finn existence".[2]

Brian's hobbies now included chemistry and crystal-set radios. But he was not obviously a future physicist: he was consistently under-achieving at school, scoring about 45% in exams. This may have been a result of ill health: scarlet fever had left him deaf in one ear and prone to constant infections. When these problems were cured, he began to show a real gift for mathematics: "It was as if I already knew [it]". He didn't get on with his physics master, who wrote, "[He] should never take up physics".[3] But that didn't stop Brian scoring a scholarship to the University of Sydney. He entered engineering, topped all six subjects in his first year, and did it again in his second year. To do Honours in engineering he had to study science, and he ended up switching to physics, largely because of his interest in electronics. In 1952 he graduated with First Class BSc Honours in Physics and the University Medal, then followed up with an MSc, also at the University of Sydney.

As a 21-year-old Honours student Brian attended the 1952 URSI Congress, held in Sydney. This event brought many of the world's radio astronomers together for the first time. Writing in 2001, Brian recalled Sir Edward Appleton's address to the first plenary session. Appleton announced that funding had been granted for what was to become the Lovell telescope at Jodrell Bank, and added that "that those of



© CSIRO

Brian Robinson

us who follow this subject … would much like to see … a similar instrument at the disposal of your radio-astronomers here in the Southern Hemisphere." Appleton also spoke of the discovery of the 21-cm hydrogen line, the possible observations it opened up, and the need to protect that frequency band for the benefit of astronomers.[4] These developments were to loom large in the careers of many Australian radio astronomers of the day, Brian among them.

On 4 May 1953 Brian began at CSIRO's Division of Radiophysics as a fixed-term Research Officer, working at the Potts Hill field station with Frank Kerr and Jim Hindman. They were building a new 12-m (36-ft) dish with which to map the southern sky at 21 cm for neutral hydrogen. By late 1953 they had observed the Magellanic Clouds at this wavelength. This was the first observation of 21-cm radiation from an extragalactic source.[5]

In 1954 Brian sailed to the UK, to take up a Royal Society Rutherford Memorial Fellowship at Trinity College, Cambridge. For his PhD thesis he tackled an ionospheric project, rather than an astronomical one per se: this may have been because relations between the Sydney and Cambridge radio astronomers were rather strained at the time.

In January 1958 he was reappointed by Radiophysics as a temporary Research Officer and sent to work at Leiden Observatory. Planning for the Parkes telescope was now well under way and Radiophysics staff were preparing for its future 21-cm observations. Brian spent four years in The Netherlands working with others to bring the receiver-noise temperature at 21 cm down from 3000 to 150 K.[6]

On his return to Australia, Brian began to use the newly commissioned Parkes telescope to observe galaxies in the Sculptor group and the Virgo cluster at 21 cm. But he was soon diverted onto another path. Astronomers thought that the hydrogen line was not the only cosmic spectral line, but the frequencies of the others were not known with any accuracy. The first of these other lines was found in1963 by a group at MIT, which discovered two absorption lines of OH at 1665 and 1667 MHz in the direction of Cassiopeia A. "On hearing this news, it occurred to John Bolton (the director of Parkes) that it should be possible to confirm and extend the discovery by looking at the strong source Sagittarius in the direction of the Galactic nucleus," Brian later recalled.[7] To do this, the Radiophysics team modified a 21-cm parametric receiver that Brian had brought from The Netherlands. The two strong OH absorption lines were easily detected. Two further lines had been predicted, originally at 1632 and 1700 MHz. They could not be found at these frequencies. However, D.W. Posener from the CSIRO Division of Electrotechnology produced new predictions of 1612 and 1720 MHz: these lines the Radiophysics team searched for, and found.[8]

Brian Robinson and Dick McGee then set out to investigate the distribution of OH near the Galactic Centre. "I remember measuring one set of the four OH lines in the direction of Sagittarius B2," Brian later recalled. "For the 1665-MHz line absorption, there was a curious spike which virtually went up to the zero line. We didn't wake up to what was going on since, shortly before, John Murray … [had] been on the lower floor of the telescope tower pulling the multi-channel filter-bank apart while we were observing. So, when Sagittarius B2 showed a peculiar lack of absorption, we assumed that John had pulled a filter out again. How wrong we were! A year later, we learned that we what we had seen in Sgr B2 was maser emission by OH." Harold Weaver at Berkeley was the first to announce the new phenomenon in print, in 1965.[9]

Despite this missed opportunity, at this time Bowen regarded Brian as "… undoubtedly one of our outstanding younger research men …", and successfully recommended his promotion to Senior Research Officer. In 1965 he became a Principal Research Scientist, and in 1968 a Senior Principal Research Scientist. In 1971 – 1972 he spent a period as Visiting Professor at the Max Planck Institut für Radioastronomie in Bonn. When the Division of Radiophysics was restructured he took up the leadership of the Cosmic Group. In 1975 he was promoted to Chief Research Scientist.

In 1968 Brian had a brief flirtation with the newly discovered pulsars: one of his 1968 chart records was reproduced on the previous Australian $50 bank note. But his major research interest was now Galactic molecules, including water and hydroxyl. In 1968 the Radiophysics group began to collaborate with chemists from Monash University, led by Ron Brown, to investigate Galactic chemistry. The chemists would suggest probable cosmic molecules, and establish their spectra in the laboratory; the astronomers would then try to find their counterparts with the Parkes telescope. The first success was thioformaldehyde (H_2CS) in 1973, followed by five more up to 1975. In 1977, in an attempt to improve Parkes' performance in this field, the original panels over the innermost 17-m diameter of the dish were replaced with panels that could operate down to 7-mm wavelengths, which was sufficient for observing silicon monoxide and ethanonitrile (CH_3CN). Then with a new receiver and an improved spectrograph the telescope's range was pushed to 3.5 mm, and spectral lines for hydrogen cyanide (HCN) and the formyl radical (HCO+) were confirmed. However, at far southern declinations the pointing accuracy was too poor for effective spectral line searches at 3.5 mm.[10]

During the early 1970s Brian led a team that investigated the siting of a new millimetre facility in Australia. "It would have been a great leap in Southern Hemisphere millimetre-wavelength research, and was years ahead of competitors anywhere in the world," says John Whiteoak, former ATNF Deputy Director. "The problem was that the plans for this coincided with plans to build the Australian Synthesis Telescope, the Compact Array forerunner. Paul Wild (the then Chief of Radiophysics) got the Astro people together for a vote and just about everyone voted for the interferometer. … After this, Brian threw in his lot with the AST project." When Bob Frater replaced Paul Wild, and took on leadership of the Australia Telescope project, Brian offered him advice on some of the political aspects of the enterprise. It was his idea, for instance, that the building of the ATCA should be designated as a Bicentennial project, which gave it greater symbolic importance.

Meanwhile, however, Brian did not abandon his interest in millimetre-wavelength astronomy, and money was found to build a 4-m millimetre-wave dish at Marsfield. This operated at up to 115 GHz. The backend was an acousto-optical spectrograph, with a bandwidth of a few hundred megahertz: by the standards of the day, this was large. Brian and his colleagues used this instrument to study the millimetre-wave transitions of interstellar molecules, and to make the first survey of CO in the Southern Hemisphere, which gave details of the Galaxy's spiral structure.

From the mid '70s Brian was involved in seeking national and international protection for the frequency bands used by radio astronomers. "In this area Brian was an unsung hero," John Whiteoak says. He was a Council Member of URSI during 1975 – 80; Chairman of the IAU Working Group on Protection of Molecular Line Frequencies 1976 – 1994; he served on the Organising Committees of the IAU Radio Astronomy and Interstellar Medium Commissions; and he was also Chairman of the Inter-Union Commission on Allocation of Frequencies (IUCAF) 1987 – 1995. "As IUCAF Chairman he was very active in obtaining the protection of the 18-cm OH spectral bands from interference from first the Russian satellite system GLONASS and then the US system IRIDIUM," says John Whiteoak. "I would say that these protection successes, and not his science, are his most important legacy to the successful future of radio astronomy, even more so than his involvement in the development of the Australia Telescope."

Brian became a Fellow of the Royal Astronomical Society in 1964, and a Fellow of the Australian Institute of Physics in 1967. In 1974 he was elected Fellow of the Australian Academy of Science: in the same year he was also awarded the Walter Burfitt Prize by the Royal Society of New South Wales for his contributions to the field of radio physics.

Brian retired from CSIRO in 1992, but remained an ATNF Fellow. For several years he and his wife Jill spent their winters on Magnetic Island, Queensland. Here Brian pursued his lifelong love of writing, penning a "Found in Space" space column for the local paper. Brian and Jill were also both interested in jazz and the visual arts: Brian played the clarinet, and in retirement he and Jill took up drawing and sculpture. In recent years Brian became a friend and supporter of Sydney installation artist Joan Brassil, helping her to incorporate pulsar sounds and references to radio astronomy into installations she created for the Art Gallery of NSW and Mount Stromlo Observatory.

Brian is survived by his wife Jill, his son Anthony, and his stepchildren Peter and Mandy.

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[1] "Vale Brian Robinson: A great Australian", *Magnetic Times*, 31 July 2004, p.1.
[2] *Ibid.*
[3] *Ibid.*
[4] *www.drao-ofr.hia-iha.nrc-cnrc.gc.ca/~kerton/graphics/appleton.html*
[5] Kerr, F. J., Hindman, J. F., Robinson, B. J. *Australian Journal of Physics* **7** (1954), 297, and Kerr, F. J., Hindman, J. V. *Astronomical Journal* **58** (1953), 218
[6] Brian Robinson, "Spectral Line Astronomy at Parkes" in *Parkes: Thirty Years of Radio Astronomy*, ed. D.E. Goddard and D.K. Milne, p. 106
[7] Raymond Haynes, Roslynn Haynes, David Malin and Richard McGee, *Explorers of the Southern Sky* (CUP 1996) p. 261
[8] Gardner, F.F., Robinson, B.J., Bolton, J.G., van Demme, K.J. 1964, *Physical Review Letters, 13, 3*.
[9] Brian Robinson, "Spectral Line Astronomy at Parkes", *op. cit.*, p. 108
[10] *Explorers of the Southern Sky, op. cit.*, p. 264.

Miriad mosaicing bug

A significant bug related to mosaicing (or primary beam correction) of specific recent data has been uncovered in Miriad. The bug affects data when all of the following apply: the data were observed since October 2003; mosaicing or primary beam correction of the data is important; the data has been loaded using the task atlod with a version date earlier than 23 October 2004, and the data have been split with the task uvsplit with a version date of 16 August 2004 or later. Note the version dates of atlod and uvsplit used on a dataset are recorded in the data history. The version dates of the currently installed versions are given whenever a task is executed. The problem becomes apparent at the imaging stage.

Users are encouraged to update their version of Miriad to eliminate the bug. A simple procedure can be used to correct the problem in existing, partially reduced data.

For more information, see *http://www.atnf.csiro.au/computing/at_bugs.html#Bug_27*

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Articles

The temperature distribution of dense molecular gas in starburst cores

Dense molecular gas is the fuel for star formation in galaxies. Its physical state is described by two parameters, temperature and density. The new 12- and 3-mm receivers at the Compact Array cover the frequencies of a large number of molecular lines and are therefore ideal to determine the physical gas conditions via multi-transition observations. In this article we present the first Compact Array results on temperature measurements of dense gas in nearby starburst galaxies using the lowest ammonia inversion lines.

Star formation (SF) is not uniform over the evolution of galaxies. Times of low-level star formation are interrupted by shorter episodes of very high SF rates (SFRs). Those starburst events are witnessed in starburst galaxies. Indeed, starburst galaxies are the most prominent contributors for SF in the local and distant universe. Their study may therefore provide important clues for a better understanding of the SF history of the universe. High mass stars are formed abundantly in starburst phases and their short lifetimes imply feedback of energy and metals to the interstellar and even to the intergalactic medium in the form of strong stellar winds and supernovae explosions. In turn, metals are important for the cooling and heating mechanisms of the interstellar/intergalactic gas which regulate the formation of subsequent stellar populations.

Recently, Gao & Solomon (2004) compared the SFRs of nearby starburst galaxies to the integrated luminosities of the CO and the HCN molecules. They concluded that HCN, a tracer for dense molecular gas (densities > 10^4 cm^{-3}) is very tightly correlated with the SFRs determined by the far infrared luminosities. The correlation is weaker when CO luminosities, which trace less dense gas, are used instead of HCN. This important result prompted us to investigate the properties of dense molecular gas in more detail and to determine its physical state in a sample of nearby, southern starburst galaxies. The brightest tracers of high density regions are transitions of molecules like HCO^+ or CS or those involved in the cyanide chemistry of molecular clouds: HCN, HNC, HCO^+, and ammonia (NH_3).

Ammonia is an excellent and easy-to-use thermometer of the dense molecular gas. This is due to its specific

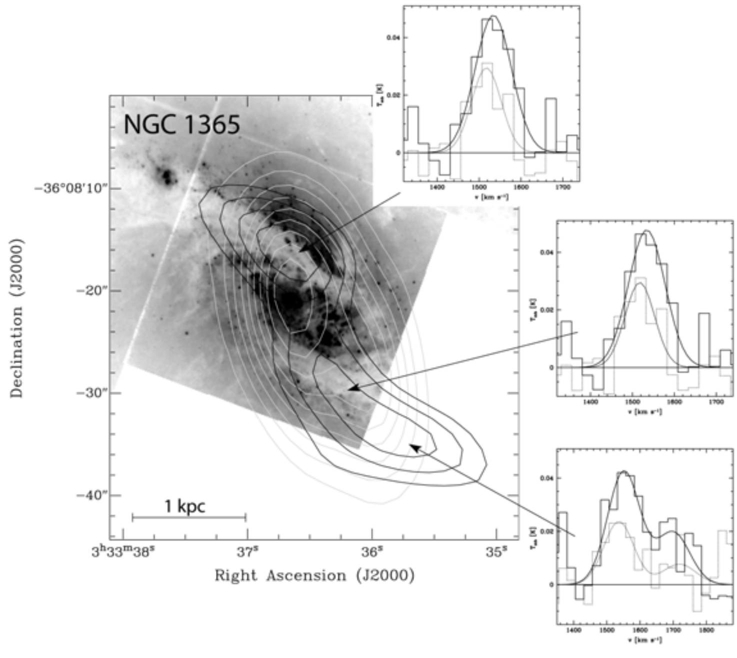

Figure 1: An HST/WFPC2 F606W optical image of the core of NGC 1365. Prominent dust absorption features are visible by their lighter colours. Overlaid as contours are the 12-mm continuum emission (light grey) as well as the ammonia (3, 3) emission (black). Spectra of ammonia (1, 1) (solid lines) and (2, 2) (dotted lines) are shown for three different positions. Gaussian fits are displayed for all detections. Rotational temperatures of the dense gas were computed from the weighted (1, 1) to (2, 2) line ratios.

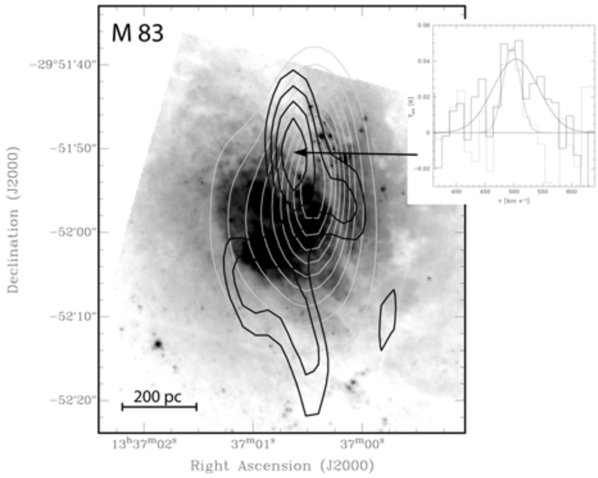

Figure 2: The ammonia content of M83. The image/contours are the same as in Figure 1 with the exception that the HST image was observed in the F814W filter and that we display NH_3 (1, 1) instead of (3, 3). Most of the dense gas is stored where optical dust features connect. Note that current star-formation (traced by 12-mm continuum emission) is mainly observed at the dense gas-stellar population interface.

tetrahedral structure where the nitrogen atom tunnels through the plane defined by the three hydrogen atoms. This effect can be observed in the 12-mm band as inversion lines emitted by metastable rotational levels. The weighted line strengths follow a Boltzmann distribution from which a rotational temperature can be determined (e.g. Ungerechts, Walmsley & Winnewisser 1986; Henkel et al. 2000).

We detected ammonia with the Compact Array in the nearby starburst galaxies NGC 253, M 83, NGC 4945, NGC 1365, and the prototypical ultraluminous infrared merger, Arp 220. In addition, ammonia was also successfully observed in the most nearby, massive elliptical radio galaxy, Centaurus A. In the ATNF annual report 2003 we showed the first ammonia temperature maps of NGC 253. Here we present results for the other galaxies in the sample.

In Figure 1, both the 12-mm continuum emission as well as the ammonia (3, 3) inversion line is overlaid on an optical HST image of the barred spiral galaxy NGC 1365 (distance ~18 Mpc, Compact Array resolution 5 – 13 arcsec). The 12-mm continuum emission is mainly caused by thermal free-free radiation and is a good indicator for the location and the rate of active SF. In NGC 1365, SF is largest in the central region which is surrounded by prominent dust lanes seen as absorption features in optical images. We were able to determine the rotational ammonia temperatures of the dense molecular gas in four distinct molecular complexes to 24 – 27 K [using NH_3 (1, 1) and (2, 2)]. This corresponds to kinetic temperatures of ~50 K. The ammonia column densities are of order 10^{13} cm^{-2} which adds up to a NH_3 mass of 35 M_{sun}.

With a mere 1.5 M_{sun}, the lowest amount of NH_3 is observed in M 83 (Figure 2; distance = 4.5 Mpc). This face-on starburst galaxy exhibits its current SF mainly at the interface between a molecular ring and its stellar interior. The main NH_3 components are observed where features of optical dust absorption connect. Such vertices appear to form the prime reservoirs of dense gas in all the galaxies of our survey. Those regions may therefore be the end-points of gas streaming along the bar toward the nucleus before the material collapses into stars. Due to limitations in signal-to-noise, a temperature determination is possible only toward the north of M 83. At this location we again derive a rotational temperature of ~25 K, which corresponds to a kinetic temperature of ~50 K.

Ammonia in emission as well as in absorption is detected in NGC 4945 (Figure 3; distance ~3.6 Mpc). The components are asymmetric with respect to the nuclear starburst core of this galaxy. While one emission and an absorption component coincide with the starburst centre, the emission extends further toward the south-west. The second absorption component is observed at a velocity offset to the systemic velocity of NGC 4945. This indicates the presence of non-circular motions of the dense gas. The temperatures of the emission and absorption components are similar to those in NGC 1365.

Finally, we present the ammonia spectra of Centaurus A and Arp 220 in Figure 4. Both objects are only observed in absorption. Centaurus A (3.7 Mpc) is the most nearby, massive elliptical radio galaxy and the temperature distribution is very ambiguous due to the very different line shapes of the NH_3 (1, 1) and (2, 2) components. Our scheduled observations of higher ammonia transitions will certainly help in the interpretation of this unexpected result. Arp 220 (distance = 78 Mpc) is the most nearby, ultraluminous infrared galaxy. In fact it is a merger of two galaxies and is commonly viewed as the archetype of a major merger in the hierarchical galaxy formation scenarios at

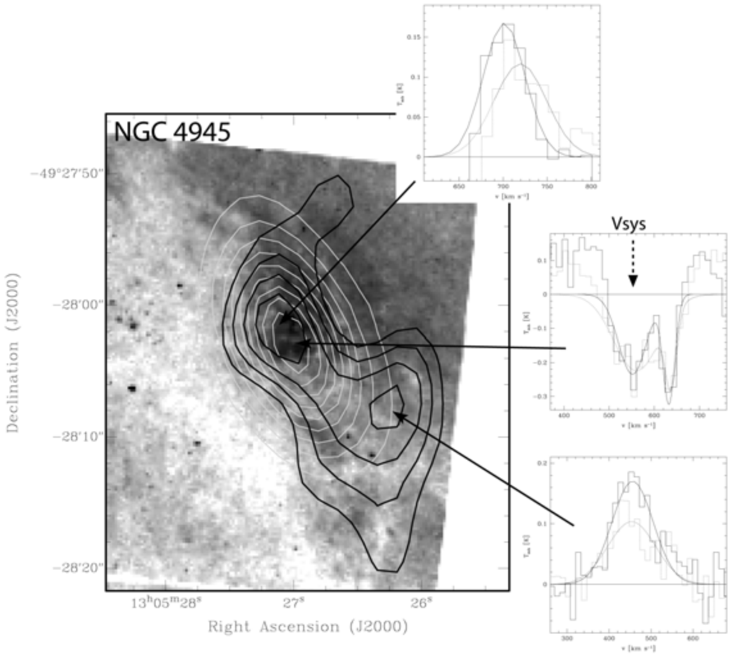

Figure 3: Ammonia (1, 1) emission within the core of NGC 4945 (see Figure 2 for details). One absorption component is observed offset to the systemic velocity of this galaxy. This is an indication for non-circular motions of the dense molecular gas.

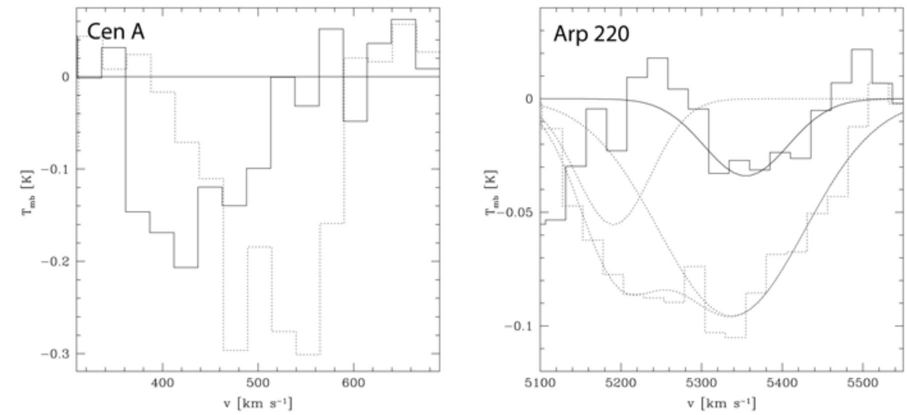

Figure 4: The ammonia (1, 1) (solid) and (2, 2) (dotted) spectra of the closest, massive elliptical radio galaxy, Centaurus A as well as for the most nearby, ultraluminous far-infrared galaxy, Arp 220. Two velocity components are detected in both galaxies (for Arp 220 the dotted Gaussian fits are displayed for the individual components as well as for their sum).

larger look-back times. The (FIR) SFR of Arp 220 is ~30 M_{sun} yr^{-1}. We observe two velocity-components in the NH_3 (2, 2) absorption spectrum and a single one in the NH_3 (1, 1) spectrum. The ammonia absorption can be attributed to the western nucleus of Arp 220. For the high-velocity component, we derive a very large rotational temperature of ~100 K. Due to the very broad NH_3 lines which partially overlap, however, this value is relatively uncertain.

In summary, we conclude that ammonia is a powerful diagnostic of temperatures of the dense molecular gas in starburst galaxies. We derive relatively uniform NH_3 rotational temperatures of ~25 – 30K [using para-NH_3 (1, 1) and (2, 2)], which correspond to kinetic temperatures of ~50K. In a continuing observing campaign, these data will be combined with HCN and HNC observations. High resolution Compact Array observations of all three species will eventually reveal the density of the molecular cores and hence complement the parameters of the physical state of this important gas phase in protostellar evolution.

References

Gao, Yu & Solomon P.M., 2004, ApJ, 606, 271
Henkel, C. et al., 2000, A&A, 361, 45
Ungerechts, H., Walmsley, C. M. & Winnewisser, G., 1986, A&A, 157, 207

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Continued from page 1

They're here

projects on the go. "As a new user of the 3-mm system I was a given a lot of support from all of the staff I came in contact with, especially Bob Sault and Juergen Ott," he said. "The telescope performed extremely well during my shifts; I didn't experience any significant problems." For the first science results from the 3-mm system, see Simon Ellingson's article in this newsletter.

The first two 3-mm systems for evaluation were fitted to the Compact Array in 2000, seeing first light on 30 November. From there to the installation of the final systems has been a long slog for many ATNF staff. "But first of all the credit goes to the engineers and technicians who designed and built the 3-mm system," said ATNF's Baerbel Koribalski, who chaired the science team of the 3-mm project for some time. "The difficulties of achieving such an innovative system were simply underestimated, but [they were] ultimately overcome, and that's what counts." High standards were set for the fabrication of components, and they were met and exceeded by both ATNF workshop staff and external service providers, such as machinists, electroplaters and manufacturers of printed circuit boards.

The key components of the new receivers are indium phosphide (InP) low-noise amplifiers (LNAs) and frequency conversion mixer MMIC chips, designed by CSIRO engineers and fabricated by Velocium, a business unit of telecommunications giant TRW (now Northrop Grumman). "One of our first issues was how to make LNAs that would give the broadband coverage we needed," said Warwick Wilson, Head of Engineering. "SIS receivers couldn't do it." And so, through connections that John Archer (CSIRO ICT Centre) had made with the US telecommunications giant TRW, the ATNF started an ambitious program of designing its own special-purpose indium phosphide devices. Koribalski recalls a visit from Steve Giugni, now Deputy Director of CSIRO's ICT Centre, probably in late 1994: "He jumped into my office and said something like, Can you find a few hundred thousand dollars? There's an opportunity to make some chips with TRW." In the end, the funding to develop millimetre-wave integrated circuits for radio astronomy and telecommunications came from a special program established by former CSIRO Chief Executive Malcolm McIntosh. The 3-mm receivers currently installed are operating at up to 105 GHz, the frequency limit imposed by the InP circuit designs; more recent designs will allow higher frequencies to be reached in future, Wilson said.

The Compact Array will now be one of the world's most sensitive millimetre arrays. Until the advent of ALMA, it will be the only Southern Hemisphere array working at short wavelengths. "The Compact Array will provide a baseline knowledge of southern millimetre sources that until now has been sorely lacking," said Tony Wong, ATNF project scientist for the 3-mm system. "This has already generated substantial interest from the prospective ALMA user community, including several groups here in Australia. The array has some intrinsic constraints – lack of short baselines, a small field of view, and a less than perfect site – but we are working to make it perform as well as possible at millimetre wavelengths," he said.

Astronomers worldwide are invited to apply for 3-mm observations next winter (May – October). Applications are due by 1 December 2004.

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Methanol masers – all class!

Methanol masers are well established as signposts of the early stages of star formation, many being associated with sources that have not developed an HII region. There are more than 20 different methanol transitions that have been observed to show maser emission and these are divided into two classes. The empirical division defined by Menten (1991) is that the class-II transitions (of which the 6.7 GHz is the best known) are closely associated with infrared sources, OH masers and HII regions. The class-I transitions are also found towards star-forming regions, but offset (up to a parsec) from infrared sources, other maser transitions etc. Theoretical models of methanol masers suggest that the class-I masers arise in an environment where collisional processes dominate and class-II masers form where radiative processes dominate. Class-I methanol masers are not known to be closely associated with any other type of astrophysical object and are relatively poorly studied. However, they are hypothesised to be associated with molecular outflows and so may be a signpost for an even earlier stage in high-mass star formation than are the class-II masers.

A search with the Mopra telescope for 95-GHz class-I methanol masers towards a statistically complete sample of 6.7-GHz class-II methanol masers achieved a detection rate of 38% (Ellingsen, 2004). Contrary to expectations in more than half the cases the velocity ranges of the two classes of masers partially overlap. However, with a single-dish it is not possible to determine the nature of the relationship between the two classes.

In late September 2004 we used the new 5-antenna millimetre system at the Compact Array in the H75 configuration to image the 95-GHz class-I masers detected at Mopra. The weather was kind and the system performed very well with a system temperature between 200 – 300 K on all antennas. We observed 5 × 5 arcminute cuts on each source at a range of hour angles and were able to determine the absolute position of the 95-GHz masers to arcsecond accuracy. The 6.7-GHz class-II masers in each of these sources have previously been imaged with the Compact Array and the new 95-GHz observations have revealed a number of surprises. In particular, they show that the emission from the class-I transition that overlaps the velocity range of the 6.7-GHz masers is often from the same region (to within an arcsecond) as the class-II maser site. Also, the class-I methanol masers are much more widely distributed throughout the star forming region than are the class-II masers.

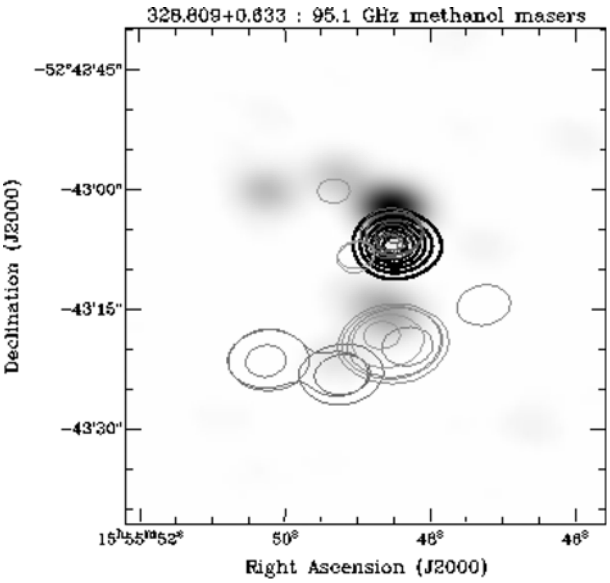

Figure 1

The figure shows our observations of 328.809+0.633, a well studied southern high-mass star forming region. The greyscale is the integrated class-I methanol maser emission, the thick contours are the 3.5-mm continuum emission (which is the site of the class-II maser emission in this source) and the thin contours are a renzogram of the class-I emission. The class-I maser emission is located in at least eight different clusters spread over a region of the order of 30 arcseconds. There is some emission from the class-I transition at the class-II maser site, but the strongest class-I masers are significantly offset from the class-II masers. The completion of the millimetre upgrade has made the Compact Array a powerful tool for studying the nature of class-I methanol masers and the high-mass star formation process.

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References

Ellingsen, S.P., 2004, submitted to MNRAS
Menten, K.M., 1991, in Haschick, A.D., Ho P.T.P. eds, ASP Conf. Ser. Vol. 16, p. 119

The quasar jets survey

Introduction

Before the launch of Chandra X-Ray Observatory on 23 July1999 our knowledge of X-ray jets was limited to only a handful of the nearest and brightest active galaxies, namely Centaurus A, M87, 3C120 and 3C273. However the huge improvement in angular resolution and sensitivity provided by Chandra has enabled the discovery of X-ray jets in abundance.

During its in-orbit commissioning phase, Chandra was turned toward the bright, southern quasar PKS 0637-752, which was expected to be a point source and thus a good target for focusing its highly polished mirrors. To everyone's surprise these observations resulted in the serendipitous discovery of a new X-ray jet (Schwartz et al. 2000; Chartas et al. 2000). This article reviews what we have learnt about PKS 0637-752 so far, describes a search for X-ray jets with Chandra and the important contribution being made by the new millimetre-system at the Australia Telescope Compact Array.

The PKS 0637-752 story

Compact Array 3 and 6-cm images of PKS 0637-752 show a bright westward-pointing jet coincident with the X-ray emission discovered by Chandra. The straight jet ends in a northward bend past which no X-rays are detected. It is also at this bend where the radio polarisation electric vectors begin to rotate from perpendicular to the jet to parallel. Archival HST data revealed three previously overlooked unresolved features at 27th magnitude coincident with the brightest parts of the X-ray and radio jets (Figure 1). These observations have allowed the emission mechanism of the jet to be investigated. The observed Spectral Energy Distribution (SED) of one of the jet features is shown in Figure 2. While the radio jet is undeniably due to synchrotron radiation because of the high linear polarisation, the emission mechanism of the X-ray jet is less clear.

The Compact Array polarisation data reveal that the magnetic field in the jet does not show Faraday rotation, implying that the X-ray emission cannot be thermal. If the X-rays are synchrotron then a simple power-law between the radio and X-ray flux densities

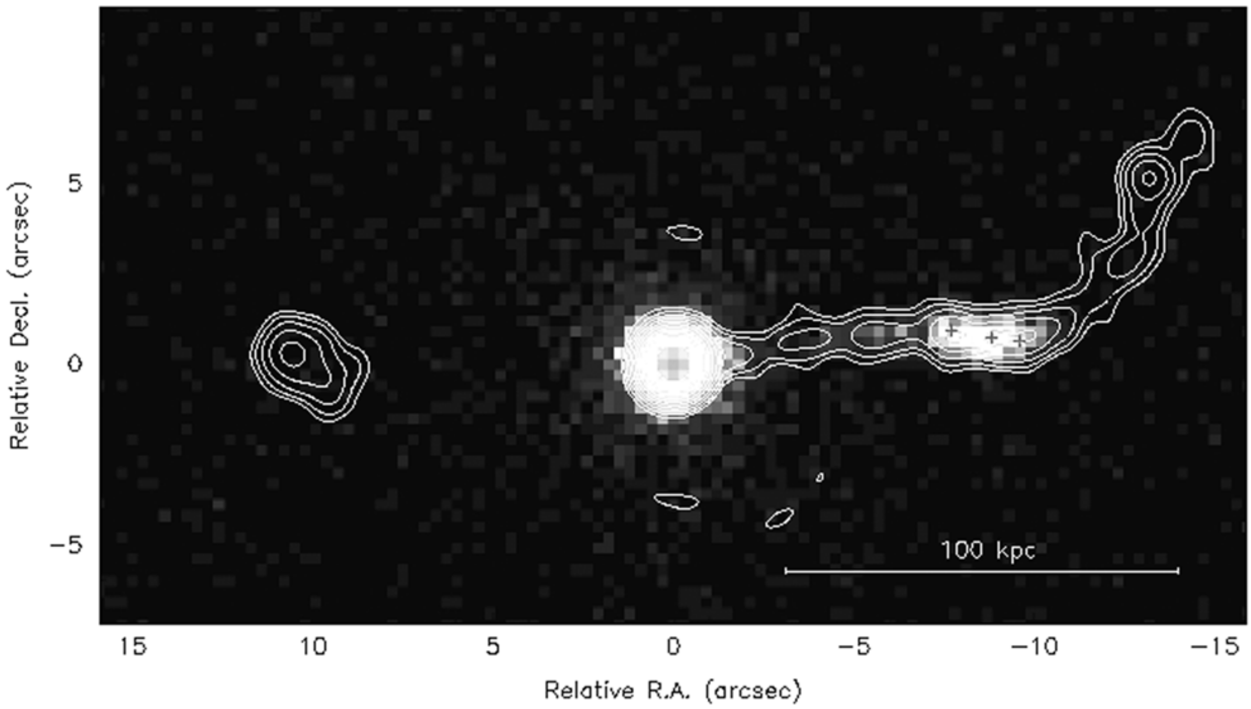

Figure 1: Compact Array 8.6-GHz (contours) and Chandra X-ray emission (pixels) in PKS 0637-752. The plus symbols indicate the location of the three unresolved jet knots detected with HST.

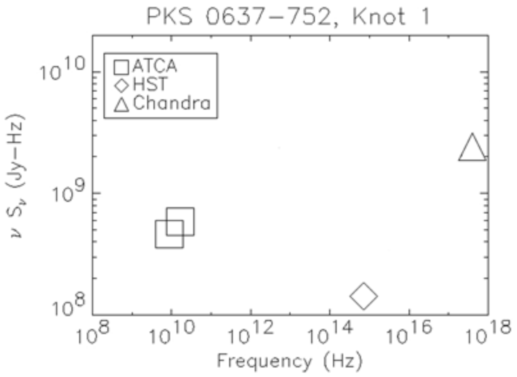

Figure 2: The spectral energy distribution of one of the knots in the jet of PKS 0637-752.

over-predicts the optical flux density by two orders of magnitude. A more probable interpretation is that the X-rays are the result of inverse Compton scattering of photons by the electrons responsible for the synchrotron radiation. The most likely source of these photons originating so far, 100 kpc, from the quasar core is the cosmic microwave background. However this still requires the kpc-scale jet to be relativistic with a bulk Lorentz factor of ~ 20 and a small angle to the line-of-sight (Celotti, Ghisellini & Chiaberge 2001). Further, the X-ray intensity of the three bright knots falls off more quickly with increasing distance from the core than in the radio which is not predicted by this model. Neither does the model explain why the X-ray emission ceases at the bend.

Clearly more work is required on modelling and the high-resolution observations of the radio jet, now available as a result of the Compact Array millimetre upgrade, can reveal sub-clumps etc, and are crucial for model refinement and furthering physical understanding of the jet.

The quasar jets survey

This discovery of the X-ray jet in PKS 0637-752 poses some interesting questions:

- How common are X-ray jets among high-power AGN?
- What conditions are required to produce them?
- What role does jet bending and polarisation play?

To help answer these questions we are undertaking an X-ray survey with Chandra of a sample of AGN with arcsec-scale radio jets. The target sources are drawn from southern hemisphere Compact Array and northern hemisphere VLA imaging surveys of flat spectrum radio sources (Lovell 1997; Murphy, Browne & Perley 1993). Sources were selected from these samples if they have emission on scales greater than 2 arcsec, allowing any X-ray jet emission to be clearly distinguished from the core. Of these sources, two sub-samples were selected for observation by Chandra:

A. Based on the predicted X-ray jet count rate. This was done assuming the radio to X-ray flux ratio of our sources was the same as PKS 0637-752. Sources were chosen if more than 30 X-ray counts were predicted.

B. Based solely on jet morphology to ensure that X-ray properties for a variety of jet types will be examined.

There are 56 AGN in the sample with a large overlap between the A and B sub-samples.

To date 20 targets have been observed by Chandra resulting in 12 new X-ray jet detections which are now the subject of detailed, multi-wavelength investigation. We find that the X-ray morphology closely follows the radio with sharp bends marking the termination of X-rays only in some cases (Figure 3). It seems that the FR-II X-ray jets can be interpreted in the same way as PKS 0637-752: as inverse Compton scattering of the Cosmic Microwave background (Marshall et al, 2004).

PKS 0637-752 revisited

The millimetre upgrade to the Compact Array is providing the opportunity to image these objects at higher resolution which will allow a more detailed investigation of the jets and their emission mechanism. In May 2004 we conducted 12-mm observations of the objects in our sample already observed with Chandra including our old friend PKS 0637-752. The 20.1-GHz image is shown in Figure 4 and reveals the kpc-scale radio jet in unprecedented detail. The gentle curve of the jet as it leaves the core is clearly seen and individual jet knots are resolved. Several of these knots in the inner jet do not appear to have clear X-ray counterparts despite the presence of overlying X-ray emission. This may be an effect of different angular resolutions of the Compact Array and Chandra images with the X-ray image showing blended emission from multiple knots, or it may be indicating significant differences in the locations of knots. We will use the new Compact Array data to model the SEDs of the knots which we hope will help understand the changing conditions along the jet and the cause of the cessation of X-rays past the northward bend.

In some cases the jets will be bright enough to be detected by the Compact Array at 3 mm and the presence of a bright compact core provides a handy in-beam phase reference.

Lastly it is interesting to note the roles played by the Compact Array and Chandra data in understanding the electron energy distribution of the jet. Under the inverse Compton interpretation the X-ray data provide

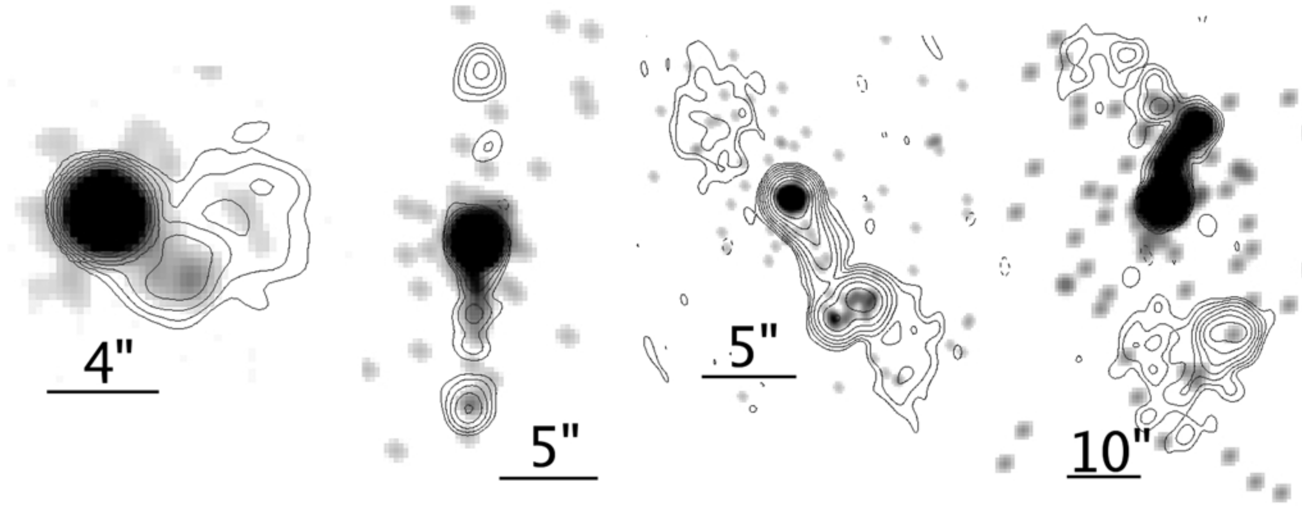

Figure 3: A selection of sources with new X-ray detections from our survey. Compact Array 8.6-GHz data are shown as contours and X-ray data convolved to the same resolution are shown as pixels. From left to right the sources are PKS 0208-512, PKS 0920-397, PKS 1030-357 and PKS 1202-252.

information on the low energy electrons while the radio data probe the high energy end of the spectrum. Thus it is the radio emission rather than the X-ray that is revealing new information on the highest energy phenomena in quasar jets!

References

Celotti, A., Ghisellini, G. & Chiaberge, M. 2001, MNRAS, 321, L1

Chartas, G. et al. 2000 ApJ 542 655

Lovell. J. 1997, PhD Thesis, University of Tasmania

Marshall, H. L. et al. 2004 ApJ Supp, accepted

Murphy, D. W., Browne, I. W. A. & Perley, R. A. 1993 MNRAS, 264, 298

Schwartz, D. A. et al. 2000, ApJ, 540, L69

Jim Lovell (ATNF), Leith Godfrey (RSAA), David Jauncey (ATNF), Geoff Bicknell (RSAA), Mark Birkinshaw (CfA/U. Bristol), Jonathan Gelbord (MIT), Markos Georganopoulos (U. Maryland), Herman Marshall (MIT), David Murphy (JPL), Roopesh Ojha (ATNF), Eric Perlman (U. Maryland), Dan Schwartz (CfA) and Diana Worrall (CfA/U. Bristol)

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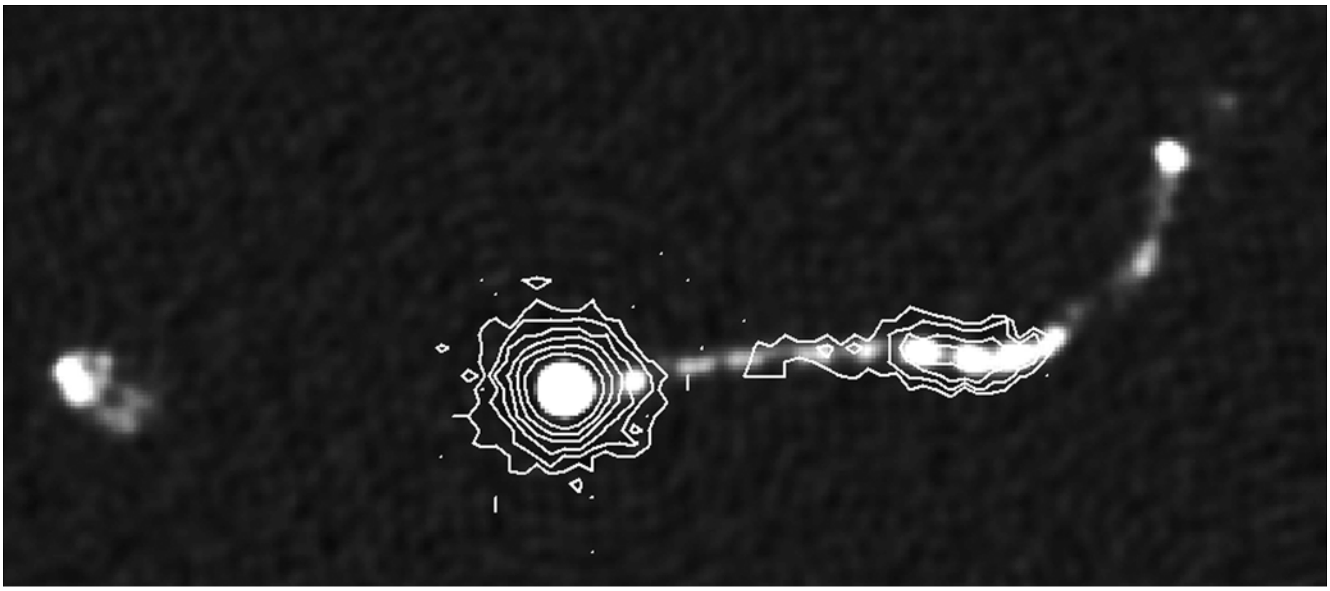

Figure 4: A string of pearls. Our recently obtained 20.1-GHz Compact Array image of PKS 0637-752 (pixels) overlayed with contours of X-ray emission.

ATNF outreach

Sport in Space competition

The *Sport in Space* competition was the ATNF's contribution to National Science Week which ran from 14 – 22 August during the Olympics. Our competition was open to school students from around Australia. We received nearly one hundred entries from schools across Australia. Students displayed great ingenuity and creativity with their work. Many of the entries were displayed the Parkes Observatory Visitors Centre during National Science Week and on the recent Open Days.

The competition had three levels of entry. Primary students wrote an illustrated tale about a sport being played somewhere in the Solar System. The winner was Jesse Webb-Smith from Geraldton, WA with his wonderful story *Rollo's Big Year Out* about the girl who named Pluto, Venetia Burney and her friend Rollo who performs gymnastics on Pluto. Junior Secondary students had to design a sport that could be played somewhere in outer space and take advantage of the special conditions there. The winners were Nichola Farnan and Aliki George, from Telopea Park School, ACT with their sport *Moon Diving*.

The winner of the Senior Secondary category was Hsu-Lynn Lee, also from Telopea Park School with her entry *Martian Dry Ice Skiing* which discussed the problems faced trying to ski on the polar ice caps of Mars. All the winning entries can be read on our outreach website at: *http://outreach.atnf.csiro.au/events/sportinspacewinners/* .

The prize for the winners was an overnight trip to the Parkes radio telescope, whilst the runners-up received book prizes. All entrants received a certificate. Unfortunately Nichola and Aliki were unable to attend as they were finalists in another national competition being held that week but fortunately one of the runners-up, Chi Kit So was able to take their place. He, Hsu-Lynn and Jesse travelled to Parkes on Monday, 16 August. They had a lengthy tour of the telescope, including a hayride and a chance to explore the Visitors Centre and 3D theatre. A wonderful, cold, clear night sky provided a chance for some star gazing. Jesse became quite a media star once home in Geraldton following his first flight to and from Sydney.

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Redevelopment of Narrabri Observatory Visitor Centre

Plans for the redevelopment of the visitor centre at the Compact Array are progressing. An exciting feature of the new centre will be a walk through artistic models of the Milky Way Galaxy and the Solar System. Visitors will be able to discover the work at the Compact Array and other facilities at the Observatory through displays and interactive exhibits spread around a circular path outside the Visitor Centre building. An observation deck with clear views down the east-west track will complete the circuit between the veranda and the current landscape paths. The plan is designed to fit with the current landscaping established in the last year and take advantage of the good views across the site. The staff that operate the telescope and astronomers from around the world who use it will feature in the displays. It will also relate their research achievements to the scale model of the Milky Way. The displays will be mostly illustrations and images with minimal amounts of text aimed at the lay person, the typical visitor to the observatory. Artists are being invited to present concepts for the galaxy and solar-system models. Several interactive design companies have also been invited to present concepts based around the plan of the displays. The plan can be viewed at *www.narrabri.atnf.csiro.au/vcplans*.

John Smith
Visitor Centre Coordinator
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Observatory Visitor Centre.

Work experience at the Narrabri Observatory

The ATNF offers the possibility of one or two weeks work experience (WE) for high school and TAFE students of normally 16 – 17 years of age. WE programs help students make future career choices by seeing what work life is like in practice. As such they form part of the ATNF's public outreach program.

At the Australia Telescope Compact Array in Narrabri we offer a wide range of subjects to which students can subscribe: astronomy, electronics, computing, administration and hospitality. Students are often local, from the Narrabri Shire, but sometimes come from further afield, either in New South Wales or elsewhere in Australia. This year, one student from England took part in the program.

The placement of WE students at the observatory is done by the WE coordinator (Michael Dahlem). The availability of WE programs at Narrabri depends primarily on the ability of potential supervisors amongst our staff to offer suitable projects at the time for one or two weeks, i.e. work that can be performed by a young student without prior knowledge of the field and with only a limited amount of time. Such projects are created on a best-effort basis and might not always be available.

Requests for WE programs are normally directed to us by the students' schools. Students are selected for available projects based on their CVs together with a sponsoring letter from their schools and a telephone interview conducted by the WE Coordinator. WE programs are governed by rules that ensure the students have insurance cover during their stay and that they perform only tasks suitable for them.

During their visit, students are shown how the Observatory operates in their chosen area, and participate in simple tasks supporting work in that area. As examples of the type of work performed, a student in computing could install an operating system on a personal computer. A student working in astronomy might assist with some aspects of astronomical data reduction or routine analysis. As part of their program students are required by their schools to keep a diary of their activities or to write an essay about their experience. Teachers from local schools often visit us briefly while their students are visiting, others will usually call on the phone to inquire about their students' progress and performance.

The WE programs at the ATNF are highly sought after. Students come to us with high expectations, knowing that they are enrolled in a program with a renowned national research organisation, which will be considered a big plus on their CVs. The ATNF, on the other hand, profits from its participation in the WE program via the positive image of its work conveyed to young Australians, who might one day make the choice to come back and work on our staff.

Finally, some statistics: We hosted six work-experience students in 2003. So far eight students have been accepted for 2004. Of these eight students, three chose astronomy, two each chose computing and electronics and one chose hospitality. Five students were from local communities, two from the Sydney area and one from abroad.

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Compact Array and Mopra report

Operations

The 2004 May term was a time of both major achievements and disruption. The major achievement has been the delivery of the 3-mm system (see cover article). The system was installed in mid-September, was quickly brought into operation and is scheduled to be used until 15 October when the “3-mm season” will be declared over. 12-mm observing continues until 28 October. Scheduled millimetre observing will then finish for the summer. A smaller but noted achievement was that the Array completed its 250th reconfiguration during the term.

The disruption at the Compact Array was caused by the late delivery of the 3-mm system. Although installation was expected to be completed by late June, this slipped to mid-September. This led to substantial changes in the observing schedule, at short notice to our observers. This caused a fair amount of disruption to our observers, particularly some overseas ones, and a good deal of additional work for many ATNF staff members. We are very grateful to the many observers who graciously took this disruption in their stride, and reorganised their timetables to use the Array.

Although most projects were rescheduled, the rescheduling of some was less than optimal. Additionally only three or four antennas were available to the earliest projects to use the 3-mm system. Expressed as a fraction of total time in the term, 4.6% of projects originally scheduled needed to be cancelled and replaced with other projects, 1.2% observed with a three-antenna system, and 2.6% observed with a four-antenna system. The majority of projects that were cancelled were for 12-mm observations as the installation of the 3-mm system disabled the 12-mm system for a period.

Although some rough edges still remain with the 3-mm systems, overall they are working very well. Above atmosphere system temperatures of 250K and an antenna sensitivity of about 25 Jy/K are achievable. Instrumental phase stability is excellent (the atmosphere is the limiting element). More complete characterisation and some corrective work for some issues with the system will take place after the end of the season.

For three weeks during August, the telescope was allocated to the AT20G project. This is an all-sky survey at 12 mm which uses an analogue 8-GHz continuum correlator and a fast scanning scheme to cover the sky in reasonable time. As this observing proposal required only three antennas, the remaining three could observe a second project in parallel. This “split-array” mode was made possible with the new LINUX-based observing system. This was the first use of the new system for scientific observations (Figure 1).

Usage statistics

Figure 2 gives the usage statistics for the Compact Array in the 2004 May term. Not unexpectedly, the fraction of maintenance and test time was substantially higher than normal. This is a result of a three-week shutdown period in June to install many of the 3-mm systems, and test time needed for final installation and commissioning work. Lost time was also somewhat higher than normal. In part this has been caused by some failures associated with new systems (mainly the 3-mm systems), but it also reflects a small number of unusual failures that occurred during the term. The

Figure 1: The Array operating in split-array mode. Antennas 2, 3 and 4 are being used in the AT20G survey, while antennas 1 and 5 are tracking a source to the east.

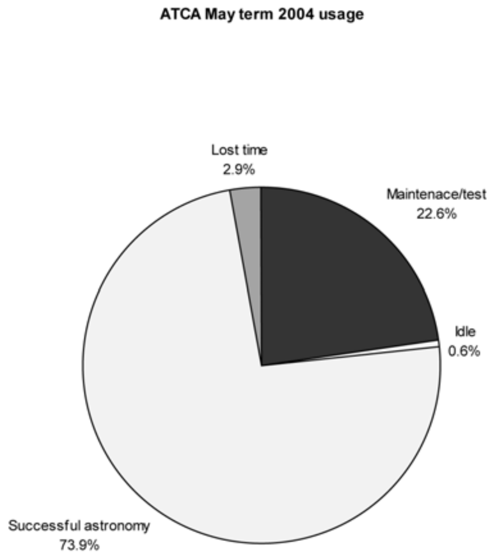

Figure 2: Compact Array usage in May term

statistics do not reflect projects that were cancelled and replaced with others or the reduced antenna availability when only 3 or 4 antennas were available with the earliest use of the new 3-mm systems.

Staff

In July we said farewell to Tim Kennedy. Tim had been with the ATNF for 10 years working as the Visitor Centre manager and was involved in a broad range of outreach activities. We thank Tim for the sterling service that he has given the ATNF over the last decade.

We also said farewell to Daron Brooke who has been one of our key RF technicians for the last six years. Most recently he has played an important role in the installation process of the new millimetre systems. Daron has been planning on moving for personal reasons for some months. We thank Daron for all his work over many years, and most recently for seeing it through to the end of the 3-mm systems installation.

Other developments

Narrabri has been successful in securing funding for a major refurbishment and development of the Control Building. This will probably also entail an extension of the building to replace the Receiver and Cryogenics Laboratory. Plans for this project are still in the very early stage. We recently were visited by a structural engineer to assess the basic integrity of the building.

Another site facility upgrade that is currently proceeding is the replacement of the copper cabling between the Control Building, the Antenna Laboratory, the Lodge and some site houses. This cabling is used by the telephones, fire alarms and site alarms. At the same time as the copper is replaced, a conduit and new fibres will be laid. A significant impetus for this work has been the increasing amount of maintenance work required to keep the alarm systems in a healthy state. A major step was needed to address this before their reliability became critical.

The atmospheric seeing monitor measurements, which are displayed on a workstation in the Control Room, are proving a very valuable tool in understanding the atmospheric phase conditions. This is particularly important as we move into routine 3-mm operation. At the time of writing, in early spring conditions, the day to night change in the phase stability can be a factor of 10 to 20.

Recently the ancillary information being stored in the Observatory’s RPFITS files has been significantly improved. The files now contain more meteorological data, reference pointing solutions, scan types, correlator configuration, seeing monitor data and logs of CAOBS commands. Observers can now enter comments that are saved with the RPFITS file and retrieved by the offline software.

Mopra

Interestingly, first light for the first of the new Compact Array 3-mm systems was 10 years almost to the hour of the first light with the SIS system at Mopra in 1994. Perhaps not surprisingly, the first source in both cases was the same SiO maser.

The last ATNF Newsletter noted that “Mopra has generated quite a few low-points and high-points” in the lead-up to its millimetre season. This pattern has continued into the season.

On the positive side, the work done to support fast raster mapping using Mopra has paid off. This is now a routine process to observe and reduce data in this fast scanning mode. The results coming from this are excellent. See the separate article on page 8.

Another pre-season round of adjustment of the antenna optics has helped to improve the antenna efficiency. A recent analysis of Mopra’s efficiency (Ladd et al.) has shown a healthy improvement with time: the subreflector work and surface adjustments have resulted in a near doubling of the efficiency in the last four years (Figure 3). Work and assistance by the Mopra operations staff has led to a smoother observing system and to observers who are more capable of exploiting Mopra’s strengths. Overall this season has probably been the most scientifically productive one for some time.

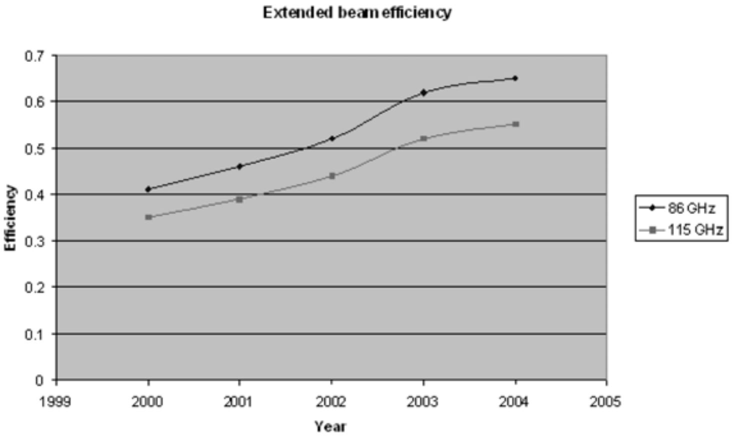

Figure 3: Change in Mopra's extended beam efficiency with time

The low points at Mopra over the season have included some persistent problems with the cryogenics system. It appears contaminants entered the cryogenic system near the start of the season, and it has taken considerable effort to expunge them. The 3-mm SIS system at Mopra works with a superconducting junction and liquid helium (at 4 Kelvin). This cryogenic system is more complex and temperamental than other ATNF cryogenic systems. However, after four cool-downs of the receiver, it is now working very well. Along the way, however, we have had several failures of the cryogenic system which resulted in lost observing time.

Another more spectacular failure (but one that did not affect observing) was an overspeed event on the Mopra backup generator. This occurred while the generator was being repaired by an external contractor, and managed to destroy the windings in the main alternator. The situation was quickly recovered: the contractor accepted liability for the damage, a hired generator was on site within 18 hours and the ATNF generator was shipped off for major repair work.

Another notable failure was a disk crash on the observing system computer. As luck would have it, this happened a few hours before a global VLBI session.

Mopra usage

Figure 4 shows the usage statistics for Mopra from the start of the Mopra millimetre season on 22 May until 1 October. There are a number of noteworthy features. The lost time is dominated by two categories: cryogenics and weather. Cryogenics accounts for 9.3 of the 18.5% of lost time. This reflects the problems that we have experienced with the 4-Kelvin system. With the planned installation of a Compact Array-style millimetre receiver package at Mopra in 2005, we expect a much simpler and more robust cryogenic system next year. Weather accounted for 6.5 of the 18.5%, and consists of both wind stows and rain conditions. Weatherwise, Mopra has had a comparatively good season.

The idle fraction is that part of the Mopra time where the telescope has been allocated to astronomy, and was capable of observing, but where it remained stowed. This is a reflection that Mopra is largely a galactic instrument and so there is a restricted LST range where it is an attractive instrument. It also reflects that the lodge facilities at Mopra are not well suited to supporting large numbers of observers or multiple observing teams.

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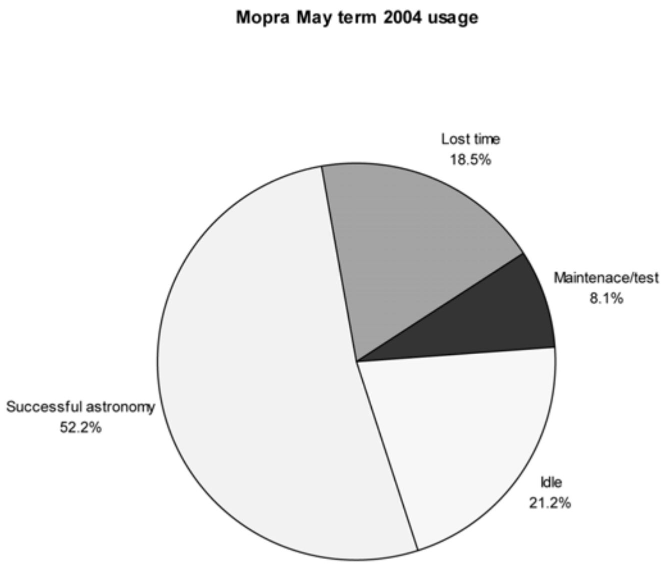

Figure 4: Mopra usage in May term

Parkes Observatory report

Staff

Jeffrey Vera recently joined us as a receiver technician, filling the position vacated by Dave Catlin some months ago. As part of the selection process Jeffrey spent a day on site assisting local staff move the 10/50-cm receiver from one translator pan to the other. This involved almost an entire day in the focus cabin. Jeffrey survived this baptism of fire and accepted the offer of a position with us, joining us on 28 September.

Ken Reeves has been filling the vacant receiver technician role for several months and has been doing a sterling job, particularly with the refurbishment of the 20-cm multibeam receiver.

Visitors Centre and outreach

In July the observatory played host to several events of the Central West Astronomy Association’s inaugural Astrofest. The festival was organised by the Central West Astronomy Society with a full program of events over the weekend 16 – 18 July. The excellent scientific program included Rev Bob Evans (supernova discoverer extraordinaire), Dr Everett Gibson of NASA, Brian Boyle (ATNF), Fred Watson (AAO), David Malin (AAO) and Jessica Chapman (ATNF).

As part of the AstroFest a successful and well-attended “Science in the Pub” was held in Parkes on Friday the 16th. On the following day David Malin delivered the inaugural “John Bolton Memorial Lecture” at a Civic reception hosted by the Parkes Shire Council. David also awarded the prizes in the Amateur astronomical photography competition. It is intended that most of these events will become regular features of an annual “AstroFest”, and the success of the first bodes well for its future.

On 28 and 29 August the Observatory opened its doors to the public and around 1150 visitors were taken on a tour of the telescope tower up as far as the junction room. Other special activities included talks on aspects of astronomy of particular relevance to Parkes and the ATNF, a chance to “Ask an Expert” anything about astronomy, the ATNF or CSIRO, and joy flights around the telescope in a helicopter.

The weekend was a great success and everything went off without a hitch – a tribute to the planning and lessons learnt from the last Parkes Open Weekend in November 2001. Informal feedback from visitors was overwhelmingly positive and it is clear that the Open Days are a tremendously effective form of outreach for the Observatory, the ATNF and CSIRO.

The efforts of the staff who gave up their own time to ensure the weekend’s success is greatly appreciated. Many staff were accompanied by family members who also gave up their time, energy and enthusiasm as volunteers. Special thanks are due to Shaun Amy, Helen Sim, Tasso Tzioumis, Rob Hollow, Tracy Hill and Bob Sault who made the effort to come to Parkes from other sites specifically to lend their assistance.

Soon after the Open Weekend, the Parkes Observatory hosted showings of some of the SCINEMA titles – short films on a variety of scientific topics featured in the National Science Week 2004 program. The films were shown at the Coventry Room of the Parkes Shire Council to small but enthusiastic audiences.

Currently the observatory is featured prominently in several television advertisements promoting Central New South Wales as a tourism destination. These ads are airing throughout NSW, ACT, Vic and South-East QLD mainly before and during school holidays.

Receivers

The biggest news from Parkes is that the 21-cm multibeam receiver has been reinstalled on the telescope after 11 months in the receiver lab. Pulse rates settled back to normal once the 500 kg dewar had been successfully winched into the focus cabin on 7 September. The multibeam dewar weighs about twice as much as the other Parkes receiver packages, and this is only the third time that it has been on the focus cabin winch.

In the time that it has been off the telescope, Brett Dawson has coordinated the replacement of 12 of the 26 low-noise amplifiers together with other substantial refurbishments of the system, ably assisted by Ken Reeves. The new LNAs were built by the Marsfield Receiver group and are the same design as those built by the ATNF for the multibeam receiver recently installed on the Arecibo Telescope in Puerto Rico.

The Parkes multibeam receiver has been in great demand since its reinstallation for both spectral-line astronomy (the Galactic All-Sky Survey pilot; McClure-Griffiths et al.) and for pulsar astronomy (the Deep Multibeam Pulsar Survey; Camillo et al.). It has been working extremely well and hopefully will continue to do so for at least a year or so until it is removed again for the second stage of the refurbishment.

The new coaxial 10/50-cm receiver was installed in the “multibeam pan” of the receiver translator when the multibeam was removed last October. The 10/50-receiver is itself very large, and it had to be moved to the downhill or lift-leg pan of the translator before the multibeam could be reinstalled.

The 10/50-cm and the 21-cm multibeam receivers together completely fill the receiver translator and there is no room for any other receiver package. Astronomy projects that require a receiver other than the 10/50-cm receiver or the multibeam will necessitate the removal of the 10/50-cm receiver. While the 10/50-cm receiver is so tall that it has to be warmed up to room temperature and split into two parts for removal from the focus cabin, this is still a much smaller operation than removing the multibeam. However, the 10/50-cm receiver is the new workhorse for pulsar timing projects, including the Pulsar Timing Array which is aimed at detecting gravity waves, and so it will only be removed for periods of a few days to a fortnight.

Interference mitigation

The 3.5-m dish from the decommissioned Parkes-Tidbinbilla microwave link has been modified by Parkes receiver group staff and is now pointing at the Mt Ulandra TV transmitter near Cootamundra. This is a significant upgrade of a system being developed to mitigate the effects of interference from new digital TV transmissions in the 50-cm band. The parabolic dish provides a much stronger reference signal from the interfering transmitter than was obtainable from the Yagi antenna used for the last few months. Cross-correlation of the reference signal and the signal from the 64-m dish enables the interference to be subtracted from the data using a variety of techniques being developed by Mike Kesteven, George Hobbs and Frank Briggs, among others.

Backends

New 8-MHz filters for the outer six beams of the multibeam receiver are nearing completion and installation is currently planned for a shutdown week in mid-October. Filters for 4 and 8 MHz were installed on the inner seven beams in 1998, but with all 13 beams operational the time required to complete narrow-band surveys will be almost halved. This is a high priority for the Galactic All-Sky Survey (GASS) which is currently in its pilot stage.

Plans to use the multibeam correlator together with the Wide-Band correlator (WBC) as a Super-Correlator are currently being fleshed out. The need for interconnections between the two correlators requires that they be co-located, and the plan is to move the multibeam correlator into RFI shielded cabinets in the upstairs control room, and move the WBC into the same cabinets. Talks with a manufacturer of suitable cabinets began last week when Brett Preisig visited their factory in Melbourne, and it is anticipated that this new capability could be available as early as February 2005.

Operations

Telescope operations have continued trouble free, with less than 1% of time lost to equipment faults in the year to date, and only 1.7% lost to weather, one of the lowest figures in memory.

Site changes

A new receiver hoist rated to one tonne has been installed in the receiver laboratory. The new hoist was required to lift the multibeam receiver, and its additional length simplifies greatly the business of ferrying receivers to and from the dish during changeovers.

The design for the upgrade of Telescope Road from the Highway to the Visitors Centre has been completed by Parkes Shire Council and is currently being reviewed by CSIRO. Once approved, work on a 2.6-km section of the road should begin almost immediately.

At the Quarters, demolition of the old laundry has been completed in preparation for the construction of the new kitchen.

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Time assignment information

Compact Array scheduling

With the installation of the 3- and 12-mm systems on the Compact Array, the requested use of the telescope in the last two terms/semesters has increased substantially. This is a great mark of success, and a gratifying result to all of those involved in the millimetre upgrades. As a result of the increased interest, observing time on the Compact Array has become more competitive. This is particularly so during the millimetre season. Observers may care to take the following into account when making proposals.

Over-subscription factors

In the 2004 May term, the oversubscription factor on the ATCA was approximately 3:1. Over one third of the time requested was with the new 3- and 12-mm systems. The oversubscription for the 2004 October semester was 2:1. The ATNF time assignment process ranks each proposal on the merits of its scientific objectives and its technical feasibility. The best proposals are scheduled, with the constraints of the very best used to help dictate some operational parameters (mainly the timing of array configurations within the term/semester). The higher oversubscription rates have meant that some good proposals that would have previously been awarded time have been unsuccessful. With the introduction of the full mm-systems, it is expected that the "millimetre season", from May to October, will remain significantly more popular and oversubscribed than the months of November-April. Time requested in this period will be more competitive.

(Note that the millimetre season is also the time that the Galaxy is a night time object, and so is also popular with Galactic spectral-line observers.)

Coordinated observations

The Compact Array is regularly scheduled in coordinated simultaneous observations with other telescopes such as satellites. For the proposers of these experiments, organising such multiple telescope proposals is often a complex undertaking. Scheduling is often an iterative affair. For the Compact Array it is somewhat more complex to schedule coordinated observations during the millimetre season than at other times. One aspect to consider is that coordinated experiments often target compact objects, and thus tend to prefer the 6-km configurations. However millimetre proposals tend to prefer compact configurations. In general the availability of 6-km arrays in the millimetre season will be more limited.

Proposers of coordinated experiments may wish to try to organise their observation when there is less chance of conflicting requirements.

Millimetre scheduling

The Compact Array can make scientifically good observations at centimetre wavelengths in almost any weather conditions except severe thunderstorms and high winds. However, good weather is essential for 3-mm observations. Typically, about 30% of time during the millimetre season is unsuitable for 3-mm observations. To give 3-mm proposals some added robustness to poor weather, a "swap scheduling" scheme has been used. Under this scheme, a partnering centimetre project is scheduled about two days after a 3-mm project. On the day of the 3-mm observing, in case of poor weather, a project can be swapped with the partnering centimetre proposal.

To simplify swaps for the centimetre observers, service mode observing is offered to suitable centimetre projects.

For the swap system to work there needs to be sufficient centimetre proposals to swap with the 3-mm proposals. However to date, the array configurations popular with millimetre observers (H75, H168 and EW214) have not proven popular with centimetre observers. In the 2004 millimetre season there were insufficient swap projects.

Observers are advised that there is potentially a significant amount of centimetre time available during the millimetre seasons for swap projects that require compact configurations. We encourage observers to consider science which can make effective use of this option. Large centimetre projects that could be used as "backups" during poor weather are also encouraged.

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ATNF publications list

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

Please email any corrections or additions to Christine van der Leeuw (Christine.vanderleeuw@csiro.au). This list includes published refereed articles that include ATNF data and other papers with ATNF staff authors, compiled since the June 2004 newsletter. Papers which include one or more ATNF staff are indicated by an asterisk.

*BAUGH, C.M., ... JACKSON, C.A., et al. "The 2dF Galaxy Redshift Survey: hierarchical galaxy clustering". MNRAS, 351, L44-L48 (2004).

BOT, C., BOULANGER, F., LAGACHE, G., CAMBRESY, L. & EGRET, D. "Multi-wavelength analysis of the dust emission in the Small Magellanic Cloud". A&A, 423, 567-577 (2004).

BROGAN, C.L., GOSS, W.M., LAZENDIC, J.S. & GREEN, A.J. "OH (1720 MHz) maser search toward the Large Magellanic Cloud". AJ, 128, 700-708 (2004).

*BURGETT, W.S, ... JACKSON, C.A., et al. "Substructure analysis of selected low richness 2dFGRS clusters of galaxies". MNRAS, 352, 605-654 (2004).

*CAMILO, F., MANCHESTER, R.N., LYNE, A.G., GAENSLER, B.M., POSSENTI, A., D'AMICO, N., STAIRS, I.H., FAULKNER, A.J., KRAMER, M., LORIMER, D.R., McLAUGHLIN, M.A. & HOBBS, G. "The very young radio pulsar J1357-6429". ApJ, 611, L25-L28 (2004).

*CASWELL, J. L. "Molecular masers of OH, methanol and water in NGC 3576, NGC 3603 and RCW 79". MNRAS, 351, 279-284 (2004)

*CASWELL, J.L. "New OH masers at 13441 MHz". MNRAS, 352, 101-111 (2004).

*CASWELL, J.L., McCLURE-GRIFITHS, N.M. & CHEUNG, M.C.M. "Supernova remnant G292.2-0.5, its pulsar, and the Galactic magnetic field". MNRAS, 352, 1405-1412 (2004).

*CHAN, B.H.P., CRAM. L.E., SADLER, E.M., KILLEEN, N.E.B., JACKSON, C.A., MOBASHER, B. & EKERS, R.D. "Faint 1.4-GHz radio sources in the 2dF Galaxy Redshift Survey". MNRAS, 352, 1245-1254 (2004).

*CRAGG, D.M., SOBOLEV, A.M., CASWELL, J.L., ELLINGSEN, S.P. & GODFREY, P.D. "Search for class II methanol masers at 23.1 GHz". MNRAS, 351, 1327-1337 (2004).

*DE PROPRIS, R., ... JACKSON, C.A., et al. "The 2dF Galaxy Redshift Survey: the blue galaxy fraction and implications for the Butcher-Oemler effect". MNRAS, 351, 125-132 (2004).

*DODSON, R., OJHA, R. & ELLINGSEN, S. P. "High-resolution observations of 6.7-GHz methanol masers with the Long Baseline Array". MNRAS, 351, 779-790 (2004).

DRAKE, C.L., BICKNELL, G.V., McGREGOR, P.J. & DOPITA, M.A. "Radio-excess IRAS galaxies. III. Radio properties". AJ, 128, 969-984 (2004).

EDWARDS, P.G. & TINGAY, S.J. "New candidate GHz peaked spectrum and compact steep spectrum sources". A&A, 424, 91-106 (2004).

*ERDOGLU, P., ... JACKSON, C.A., et al. "The 2dF Galaxy Redshift Survey: Weiner reconstruction of the cosmic web". MNRAS, 352, 939-960 (2004).

GONTHIER, P.L., VAN GUILDER, R. & HARDING, A.K. "Role of beam geometry in population statistics and pulse profiles of radio and gamma-ray pulsars". ApJ, 604, 775-790 (2004).

*HAN, J.L., FERRIERE, K. & MANCHESTER, R.N. "The spatial energy spectrum of magnetic fields in our Galaxy". ApJ, 610, 820-826 (2004).

HARNETT, J., EHLE, M., FLETCHER, A., BECK, R., HAYNES, R., RYDER, S., THIERBACH, M. & WIELEBINSKI, R. "Magnetic fields in barred galaxies. III. The southern peculiar galaxy NGC 2442". A&A, 421, 571-581 (2004).

*HAVERKORN, M., GAENSLER, B.M., McCLURE-GRIFFITHS, N.M., DICKEY, J.M. & GREEN, A.J. "Magnetic fields and ionized gas in the inner Galaxy: an outer scale for turbulence and the possible role of HII regions". ApJ, 609, 776-784 (2004).

*HOBBS, G., FAULKNER, A., STAIRS, I.H., CAMILO, F., MANCHESTER, R.N. et al. "The Parkes Multibeam Pulsar Survey. IV. Discovery of 180 pulsars and parameters for 281 previously known pulsars". MNRAS, 352, 1439-1472 (2004)

*HOTAN, A.W., VAN STRATEN, W. & MANCHESTER, R.N. "PSRCHIVE and PSRFITS: an open approach to radio pulsar data storage and analysis". PASA, 21, 302-309 (2004).

JACKSON, D.C., SKILLMAN, E.D., CANNON, J.M. & COTE, S. "HI observations of the Local Group dwarf WLM". AJ, 128, 1219-1227 (2004).

*KLAMER, I.J., EKERS, R.D., SADLER. E.M. & HUNSTEAD, R.W. "Molecular gas at high redshift: jet-induced star formation?". ApJ, 612, L97-L100 (2004).

*KLAMER, I., SUBRAHMANYAN, R. & HUNSTEAD, R.W. “A binary system of tailed radio galaxies”. MNRAS, 351, 101-109 (2004).

*KORIBALSKI, B.S., STAVELEY-SMITH, L., KILBORN, V.A., RYDER, S.D., BARNES, D.G., RYAN-WEBER, E., EKERS, R.D., JERJEN, H., HENNING, P.A., KRAAN-KORTEWEG, R.C., PUTMAN, M.E., ZWAAN, M.A., DE BLOK, W.J.G., CALABRETTA, M.R., DISNEY, M.J. et al. “The 1000 brightest HIPASS galaxies: H I properties”. AJ, 128, 16-46 (2004).

*KREGEL, M., VAN DER KRUIT, P.C. & DE BLOK, W.J.G. “Structure and kinematics of edge-on galaxy discs. II. Observations of the neutral hydrogen”. MNRAS, 352, 768-786 (2004).

*LONDISH, D., HEIDT, J., BOYLE, B.J., CROOM, S.M. & KEDZIORA-CHUDCZER, L. “2QZJ 215454.3-305654: a radio-quiet BL Lacertae object or lineless quasi-stellar object?”. MNRAS, 352, 903-908 (2004).

*MANCHESTER, R.N. & HAN, J.L. “Polarization observations of nine southern millisecond pulsars”. ApJ, 609, 354-362 (2004).

*MASHCHENKO, S., CARIGNAN, C. & BOUCHARD, A. “Impact of ultraviolet radiation from giant spirals on the evolution of dwarf galaxies”. MNRAS, 352, 168-180 (2004).

McKAY, N.P.F. et al. “The discovery of new galaxy members in the NGC 5044 and 1052 groups”. MNRAS, 352, 1121-1134 (2004).

*McLAUGHLIN, M.A., KRAMER, M., LYNE, A.G., LORIMER, D.R., STAIRS, I.H., POSSENTI, A., MANCHESTER, R.N. et al. “The double pulsar system J0737-3039: modulation of the radio emission from B by radiation from A”. ApJ, 613, L57-L60 (2004).

*OHISHI, M., MORI, M. & WALKER, M. “Gamma-ray spectra due to cosmic-ray interactions with dense gas clouds”. ApJ, 610, 868-875 (2004).

*ORCHISTON, W. & BUCHANAN, A. “‘The Grange’, Tasmania: survival of a unique suite of 1874 transit of Venus relics”. J. Astron. History & Heritage, 7, 34-43 (2004).

*ORCHISTON, W. et al. “The IAU Historic Radio Astronomy Working Group. 1. Progress report”. J. Astron. History & Heritage, 7, 53-56 (2004).

*ORCHISTON, W. et al. “The IAU Astronomical Archives Working Group. 2. Progress report”. J. Astron. History & Heritage, 7, 61-63 (2004).

*ORCHISTON, W. et al. “The IAU Historical Instruments Working Group. 1. Progress report 2003-2004”. J. Astron. History & Heritage, 7, 57-58 (2004).

*ORCHISTON, W. et al. “The IAU Transit of Venus Working Group. 3. Progress report”. J. Astron. History & Heritage, 7, 50-52 (2004).

ORD, S.M., VAN STRATEN, W., HOTAN, A.W. & BAILES, M. “Polarimetric profiles of 27 millisecond pulsars”. MNRAS, 352, 808-814 (2004).

*OSTEN, R.A., BROWN, A., AYRES, T.R., DRAKE, S.A., FRANCIOSINI, E., PALLAVICINI, R., TAGLIAFERRI, G., STEWART, R.T., SKINNER, S.L. & LINSKY, J.L. “A multiwavelength perspective of flares on HR 1099: 4 years of coordinated campaigns”. ApJS, 153, 317-362 (2004).

*PADILLA, N.D., ... JACKSON, C.A., et al. “The 2dF Galaxy Redshift Survey: the clustering of galaxy groups”. MNRAS, 352, 211-225 (2004).

*PISANO, D.J., BARNES, D.G., GIBSON, B.K., STAVELEY-SMITH, L., FREEMAN, K.C. & KILBORN, V.A. “Where are the high-velocity clouds in Local Group analogs?”. ApJ, 610, L17-L20 (2004).

SCHNEIDER, N. & BROOKS, K. “The bias of molecular clump identification programs: the example of the Carina molecular clouds”. PASA, 21, 290-301 (2004).

*SCHOIER, F.L., OLOFSSON, H., WONG, T., LINDQVIST, M. & KERSCHBAUM, F. “Probing the inner wind of AGB stars: interferometric observations of SiO millimetre line emission from the oxygen-rich stars R Dor and L2Pup”. A&A, 422, 651-663 (2004).

SICARD, A., BOURDARIE, S., KRUPP, N., LAGG, A., BOSCHER, D., SANTOS-COSTA, D., GERARD, E., GALOPEAU, P., BOLTON, S., SAULT, R.J. & WILLIAMS, D.J. “Long-term dynamics of the inner Jovian electron radiation belts”. Advances in Space Research, 33, 2039-2044 (2004).

*STEVENS, J.B., WEBSTER, R.L., BARNES, D.G., PISANO, D.J. & DRINKWATER, M.J “The HI content of compact groups of galaxies”. PASA, 21, 318-333 (2004).

*STIL, J.M., TAYLOR, A.R., MARTIN, P.G., ROTHWELL, T.A., DICKEY, J.M. & McCLURE-GRIFFITHS, N.M. “GSH 23.0-0.7+117: a neutral hydrogen shell in the inner Galaxy”. ApJ, 608, 297-305 (2004).

*WANG, M., HENKEL, C., CHIN, Y.-N., WHITEOAK, J.B., HUNT CUNNINGHAM, M., MAUERSBERGER, R. & MUDERS, D. “Dense gas in nearby galaxies. XVI. The nuclear starburst environment in NGC 4945”. A&A, 422, 883-905 (2004).

*WANG, N., JOHNSTON, S. & MANCHESTER, R.N. “13 years of timing of PSR B1259-63”. MNRAS, 351, 599-606 (2004).

*WARREN, B.E., JERJEN, H. & KORIBALSKI, B.S. “ESO 215-G?009: an extreme HI-rich dwarf irregular galaxy”. AJ, 128, 1152-1166 (2004).

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