ATNF News

Issue No. 43, February 2001

ISSN 1323-6326

FEATURES IN THIS ISSUE

First millimetre light for upgraded Australia Telescope

The MNRF science and engineering team

Installed and tested in late November 2000, new world-leading technology has made the Australia Telescope Compact Array (ATCA) the first millimetre-wave interferometer in the Southern Hemisphere. At the heart of the new millimetre receivers are indium phosphide chips, cooled to 20 K (-253° C), the product of a joint effort between the Australia Telescope National Facility (ATNF) and the CSIRO Division of Telecommunications and Industrial Physics (CTIP).

On Thursday 30 November 2000, three years of designing, building, and testing for the Narrabri and Sydney engineering groups came to a climax at the ATCA when two of the six dishes were fitted with the new 3-mm receiving systems and trained on a star-forming region within the Orion nebula containing silicon monoxide (SiO) masers. At 11.45 pm the telescope captured its first cosmic millimetre-wave photons, achieving "first light". Figure 1 shows the cross-power spectrum resulting from these first observations, at a frequency of 86.243 GHz. The millimetre photons from this source are produced by excited SiO molecules which are embedded within the star-forming clouds.

Currently a project science team is using the ATCA in its 3-mm observing mode,

Continued on page 13

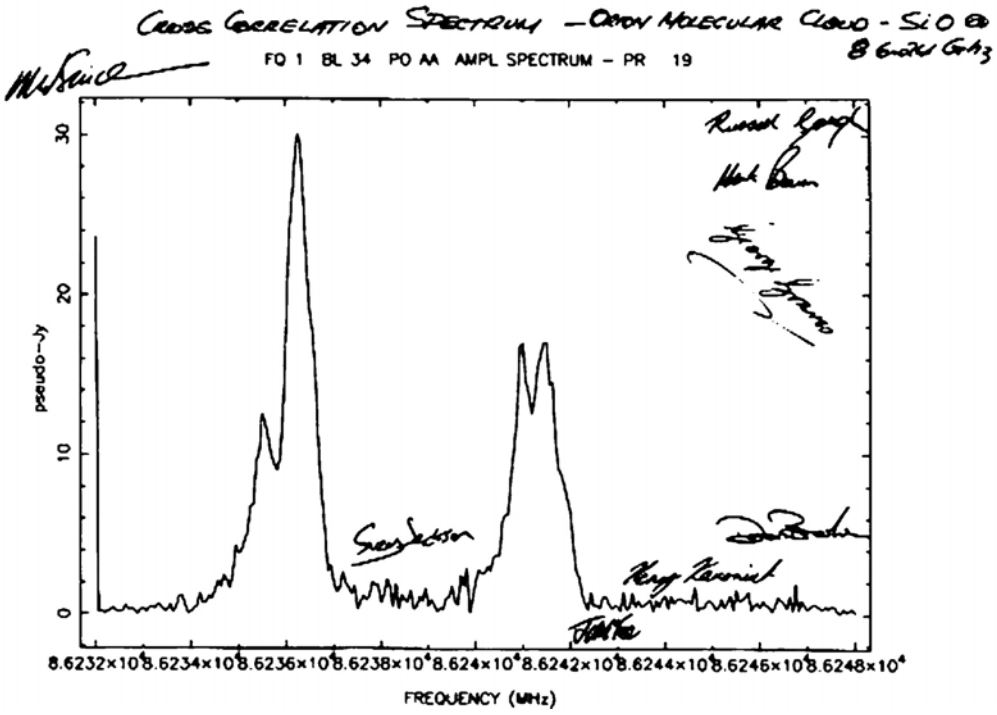


Figure 1: "First light" - the Australia Telescope's first observation as an interferometer working in the 3-mm band with a single baseline of length 31 m. The spectrum shows the SiO maser emission from a star-forming region in the Orion nebula. The integration time was several minutes. No calibration has been applied.

Editorial

Welcome to the February 2001 issue of ATNF News. From October 2000 the ATNF News has been available in an online format at http://www.atnf.csiro.au/news/newsletter. We encourage our readers to take advantage of the online edition: back issues will be readily accessible; HTML links included with the articles are "live"; online issues are searchable by keyword; illustrations are rendered in colour (as opposed to black and white in the printed version). In short, the online edition of the ATNF News provides a richer experience than the printed version. With the online version we also provide an ATNF News feedback form that allows you to change your contact information in a convenient way or to send us feedback on the ATNF News and web pages.

For important information on changes to available observing facilities see the Time Assignment item on page 20.

Contributions to the ATNF News and science reports are welcome at any time. Please send these by email to the editors at newsletter@atnf.csiro.au.

Steven Tingay, Jo Houldsworth and Jessica Chapman
ATNF Newsletter Team
(newsletter@atnf.csiro.au)

Contents

News items

ATNF Deputy Director awarded Public Service Medal on eve of departure

Dr. John Whiteoak, Deputy Director of the Australia Telescope National Facility since1989, has been awarded a Public Service Medal in the Australia Day honours for his contribution to the ATNF and his role in establishing high-frequency spectrum allocations for astronomical research.

One of John's major contributions in the international radio astronomy world has been his work on the protection of radio frequencies for astronomy, as chairman of an International Telecommunications Union (ITU) Working Party (WP7D). This group has proposed vastly increased protection in the radio spectrum at frequencies between 71 and 275GHz, the proposals endorsed at the recent World Radiocommunications Conference in Istanbul (see the October issue of the ATNF newsletter).

John retired from the ATNF in February 2001 after a highly distinguished career. He first joined the CSIRO Division of Radio Physics in 1965 and was the Project Secretary during the construction of the Australia Telescope. Since 1989 he has been the Deputy Director of the Australia Telescope. The "John Bartlett Whiteoak Scientific Symposium" was held at the ATNF headquarters on 7th February 2001 to honour his career and many contributions which have included three years as Office-in-Charge at Narrabri, an immense scientific output, many former students who have gone on to become professional astronomers and his role with the ITU .

We all wish John and his wife Mary well for their retirement.

Steven Tingay, Jessica Chapman
(Steven.Tingay@atnf.csiro.au)

Dr. John Whiteoak with Anna Fullerton (1999/ 2000 summer vacation student) on the Mopra telescope.

Incoming Deputy Director

Following the retirement of Dr. John Whiteoak, Prof. Ray Norris has been appointed Deputy Director of the ATNF, with overall responsibility for Astrophysics, Computing, National Facility Support and Parkes and Narrabri Observatories.

Mr. John Brooks will continue as Assistant Director and Engineering Manager, with responsibility for the ATNF Finances, Research Support and all Engineering Groups.

In addition, Dr. Lister Staveley-Smith has now taken over the position of Head of Astrophysics and Dr. Neil Killeen is Head of the Epping Astronomical Computing Group.

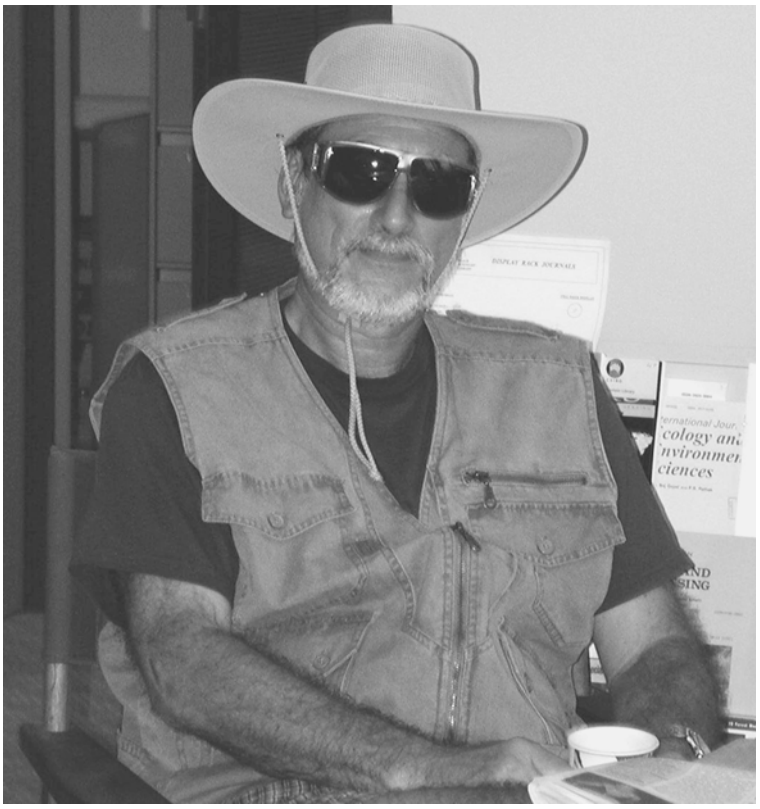
Steven Tingay
(Steven.Tingay@atnf.csiro.au)

VSOP Survey meeting

The ATNF Canberra office hosted a meeting of the nucleus of the data reduction team for the VLBI Space Observatory Programme (VSOP) Survey Program, 10–24 November 2000. Each VSOP Survey observation is made using the HALCA satellite in conjunction with typically three ground telescopes over a six hour HALCA orbit. For the Southern Hemisphere component of the Survey, antennas at Mopra, Hobart, Ceduna and Hartebeesthoek are major contributors.

One of the main aims of the Survey is to study the statistical properties of active galactic nuclei at sub-milliarcsecond resolution, corresponding to brightness temperatures above 10^{12} K (Hirabayashi et al., Publ. Astron. Soc. Japan 52, 997-1014, 2000). The complete VSOP Survey sample includes all catalogued extragalactic radio sources in the sky with a total flux density at 5 GHz greater than 0.95 Jy, spectral index $\alpha > -0.45$ (where $S \propto \nu^{\alpha}$), and Galactic latitude $|b| > 10°$. In addition, 37 extragalactic sources with total flux densities greater than 5 Jy were included regardless of their spectral index and galactic latitude. Sources from this sample of 402 sources which did not have a correlated flux density greater than 0.3 Jy on long Earth baselines were excluded from the subset selected for VSOP observations. As of 2000 December, 195 of the 289 selected sources (69 per cent) have been observed.

With over 100 observations reduced so far, much of the meeting concentrated on assessing the data calibration to ensure consistency in the final Survey product. The data reduction team were able to closely compare data from different ground arrays and from different correlators and in doing so were able to identify areas that require attention. In particular, understanding the flux density scale was given a high priority and ATCA flux monitoring data combined with the VLBA Pre-Launch Survey data were most useful in achieving this.



Ed "Crocodile Dundee" Fomalont prepares for his trip to central Australia

The meeting was attended by Richard Dodson (University of Tasmania), Ed Fomalont and George Moellenbrock (NRAO), Shinji Horiuchi (NAO, Japan), Jim Lovell (ATNF) and Bill Scott (University of Calgary).

Following the Survey meeting, Ed and George visited ATNF in Marsfield where Ed presented a colloquium on "The Evolution of the radio lobes in Sco-X1".

More information on the VSOP Survey can be found at http://www.vsop.isas.ac.jp/survey

Jim Lovell
(Jim.Lovell@atnf.csiro.au)

The search for a Radio-quiet Reserve

The ATNF is actively involved in looking for possible sites for a Radio-quiet Reserve in Western Australia. Two aspects of this project are currently being intensively studied: the degree of mineral prospectivity across the 50-km diameter areas of possible locations, and the planning of a comprehensive electromagnetic measurement program.

The first of these studies is being carried out by the Western Australian Department of Minerals and Energy. It is essential to ensure that any area being considered as a Radio-quiet Reserve does not have significant minerals, which could be exploited over the planned 100-year life time of a protected reserve.

The second aspect relates to the planning of a series of measurement programs to ultimately characterise the radio quietness of one or more appropriate sites. The first stage of this program will be a trial sample run on Mileura Station, 100 km west of Meekatharra (population 2000) in late March this year. An experienced consultant has been appointed by the Western Australian Government to carry out the measurements with input from a Western Australian communications engineer and CSIRO. Frequency bands from 30 MHz to 1.7 GHz will be sampled for possible Low Frequency Array (LOFAR) and Square kilometre Array (SKA) applications.

The New South Wales Government recently expressed interest in the provision of a site for a Radio-quiet Reserve in the northwest of the State; discussions have commenced with the NSW Department of State and Regional Development.

Bruce MacA Thomas
SKA Site Engineer, ATNF
(bthomas@atnf.csiro.au)

ATNF symposia and workshops - February to June 2001

On 25–29 June 2001 the ATNF and the Anglo Australian Observatory (AAO) will jointly sponsor a workshop titled “AGN Variability Across the Electromagnetic Spectrum”. For details see http://www.atnf.csiro.au/people/lkedzior/agn_workshop.html.

On 14 April 2001 the ATNF graduate students will present work from their projects at a special symposium. For details see http://www.atnf.csiro.au/research/conferences/student_symposia/ASS2001/.

The annual ATNF/AAO joint symposium will be held on 23 March 2001.

On 9 February 2001, a summer vacation student symposium was held for the 2000/2001 ATNF and CTIP vacation students to present work from their summer projects.

On 8 February 2001 a meeting of the Australian Square Kilometre Array (SKA) groups was held, covering “Australian Perspectives and Directions”. See http://www.atnf.csiro.au/SKA/Aust_SKA_Symp_Home.html.

On 7 February 2001 a special symposium was held to honour Dr. John Whiteoak, retiring Deputy Director of the ATNF.

On 6 February 2001, the “ATNF Australian Workshop on Clusters of Galaxies” was held. The workshop was aimed at promoting multi-disciplinary links between groups studying galaxy clusters and generating enthusiasm for new cluster research in Australia. For details see http://www.atnf.csiro.au/research/conferences/cluster2001/.

On 5 February 2001, a HIPASS (HI Parkes All-Sky Survey) science meeting was held. For details see http://www.atnf.CSIRO.AU/research/multibeam/meet/20010205.html.

Steven Tingay, Jessica Chapman
(Steven.Tingay@atnf.csiro.au)

news

Australia Telescope User Committee report

The second Australia Telescope User Committee (ATUC) meeting for 2000 was held at the ATNF headquarters, Marsfield, on 26 and 27 October 2000. There were 13 members in attendance and the meeting was chaired by Dr. Anne Green.

Appreciation was expressed for the contribution of the outgoing Secretary of the past two years, Dr. Baerbel Koribalski, and a warm welcome was extended to six new members:

Mr. Vince McIntyre (incoming Secretary); Dr. David Barnes; Dr. Simon Ellingson; Dr. Carole Jackson; and student representatives Ms. Hayley Bignall and Mr. Eric Muller

An open session was held on 26 October and included reports from the ATNF Director and the Observatory Managers, as well as updates on all developments pertaining to the ATUC. A formal business session was held on 27 October. Some of the highlights from the discussions were:

(1) ATUC was very pleased with the progress of the outreach program, and congratulates ATNF on the establishment of the graduate student program and the research scholarships. We continue to encourage an increased profile and public awareness for ATNF achievements, in both scientific and technological areas;

(2) ATUC strongly endorses ATNF support for institutional researchers, with co-operative programs, joint funding and improved accommodation in Marsfield. It is suggested that the next synthesis imaging school be held in Narrrabri, in September 2001;

(3) Key Performance Indicators are now required for all areas of ATNF operations and some statistics were submitted for ATUC, based on the status of recommendations made to the ATNF management over the previous 12 months. Items were categorised as successfully completed, in progress, or not done, and this gives a measure of the effectiveness of ATUC in influencing ATNF policy decisions;

(4) Several items dealt with specific issues connected with the efficiency and quality of observing. Positive feedback was given to both the AIPS++ development team and those responsible for web-based information and tools. The outsourcing of IT support was viewed negatively;

In total, 16 recommendations were made in the report presented to the Director at the end of the meeting. The full agenda and report of this ATUC meeting and those from previous years can be found on the web at:

http://www.atnf.csiro.au/overview/atuc

The next ATUC Meeting will be held 20 - 21 March 2001 at the RP Laboratory Epping.

Anne Green, University of Sydney
Chair, ATUC
(agreen@physics.usyd.edu.au)

ATNF Astrofest meetings

In order to liven up the regular astrophysics group meetings, it was agreed some time ago that two of the regular business meetings each year be replaced by science-oriented meetings. We have now had two of these so-called astrofests. The program for the last one on 13 December 2000 can still be found on the web at http://www.atnf.csiro.au/research/astro/astrofest-13-Dec-2000.html. This latest meeting proved to be an exciting forum for the discussion of Active Galactic Nuclei and their variability, polarimetry, pulsars and HI in nearby galaxies. An AIPS++ image demo also proved popular.

Although originally aimed as a forum for the astrophysics group to discuss science and communication, the astrofests have proved popular among visitors, students, National Facility users and other ATNF groups. As a result, we welcome anyone to attend, and anyone with an ATNF-related result to give a short presentation at future meetings. The next astrofest is presently scheduled for 6 June 2001.

Lister Staveley-Smith
ATNF Astrophysics Group Leader
(Lister.Staveley-Smith@atnf.csiro.au)

CSIRO Summer Vacation Scholarship Program

December 2000 to February 2001 marked the CSIRO Summer Vacation Scholarship Program with the Australia Telescope National Facility and Telecommunications and Industrial Physics (at both the Marsfield and Lindfield sites) participating. There were 170 applications for the 20 positions, seven with the ATNF (two of these at the Narrabri Observatory) and 13 for CTIP. The students worked on projects with a scientist or an engineer for a period of 10-12 weeks.

The students experienced the working environment of a major research facility. The program included: a series of introductory lectures on the work of the ATNF and CTIP; a tour of the CSIRO Marsfield and Lindfield laboratories; and a weekly afternoon tea session where a staff member, or specially invited guest, talked on a topic of their choosing.

A highlight of the program was the observatory trip where the students, in teams of 2-4, were given the opportunity to work on a project of their own choice, at either the Parkes radio telescope or the Australia Telescope Compact Array at Narrabri. The observatory trip was attended by John Whiteoak (Parkes) and Bob Sault (Narrabri).

We give a huge thank you to John Whiteoak, as this was his last participation in the program. John has contributed greatly to the Summer Vacation Scholarship Program and has provided many students the opportunity to continue to further their studies and goals with the ATNF Higher Degree Scheme. We wish John good luck in his retirement.

The program concluded with a Summer Vacation Students' Symposium, organised by the students themselves, which was held on Friday 9 February 2001 at the Radiophysics Laboratory Lecture Theatre in Marsfield, followed by a farewell dinner.

Advertisements for the next round of the Summer Vacation Scholarship Program will be distributed around mid-June to all Australian universities and will also appear at:

http://www.atnf.csiro.au/educate/summer_vacation/summer_info_page.html.

Lucia M Bromley-Gambaro, ATNF
(lgambaro@atnf.csiro.au)

Standing left to right: Jessica Chapman (ATNF), Jenna Hall, Tim Connors, Ashish Choudhary, Edward Boyce, Paul Beasly, Susan Rennie, Ilana Klamer, David Neo, Diem Vu Thanh, Karina Kiely, Bob Sault (ATNF), Lucia Bromley-Gambaro (ATNF). Sitting left to right: James Brinkhoff, Ivan Mac, Benjamin Lippmeier, Elizabeth Claridge, Ian Manchester, Peter Woloszyn, Ashley Smart.Absent: Samantha Coras, Arthur Dimitrelis, Leigh Milner, Geoff Poulton (CTIP)

Articles

Recurrent activity in giant radio galaxies

Giant radio galaxies constitute a class of radio sources with linear sizes on the megaparsec scale (Saripalli 1988). In a study of the radio morphologies in giant radio galaxies carried out with the ATCA, Subrahmanyan, Saripalli & Hunstead (1996) drew attention to a variety of morphological features in the giant sources which were indicative of interrupted or episodic nuclear activity and concluded that "giant radio galaxies may have attained their large sizes as a result of a restarting of their central engines in multiple phases of activity along roughly similar directions".

The Westerbork Northern Sky Survey (WENSS) has discovered several cases of "inner-double" or "double-double" giant radio galaxies: the findings suggest that such structures predominantly occur among the larger of radio galaxies. However, only a small number of giant radio galaxies show double-double structures (Schoenmakers et al. 2000). The formation of visible shocks as a restarted beam ploughs through the relic cocoon probably necessitates a high density in the cocoon. This implies that if restarting beams are to be seen in radio images, the initial radio source would have to have evolved over sufficient time so that enough ambient material could have been entrained in its cocoon plasma (Kaiser et al. 2000). This argument is supported by the derivation of consistently larger spectral ages for the giant radio galaxies as compared to smaller radio galaxies (Mack et al. 1998).

Studies of the nuclear recurrence phenomenon in giant radio galaxies are in their early days. As yet, the role of recurrent activity in the formation of giant structures is not clear as also the more fundamental question of whether there is a link between the double-double structure and recurrent central engine activity. We have been following up on our earlier work with detailed ATCA observations of the southern giant radio galaxies whose morphologies indicate the possibility of interrupted activity. An example of such a source is discussed here.

Figure 1 shows an ATCA 20-cm image of B0114-476. The most intense feature is the symmetric, edge-brightened inner double which is seen to stand out as a structure separate from the diffuse lobe emission extending over very much larger scales. We are inclined to believe that the outer diffuse lobes which lack hotspots represent relics of past activity and the inner lobes represent a new injection of energy as a result of the restarting of the nuclear activity following an interruption.

The inner double itself has a linear size of 700 kpc: its size is much larger than typical double radio galaxies. Close to the core of B0114-476, a narrow jet-like feature is seen directed toward the southern inner lobe which also has the brighter hotspots. In the lobes of powerful radio galaxies, one sees a distribution of spectral index with flatter values at the ends and steepening towards the inner regions. However, in the inner lobes of B0114-476, we see no indication of spectral index variation along the length of the lobes: the relative constancy of the spectral index may be symptomatic of the different conditions under which it has formed.

The southern lobe of B0114-476 appears to end along what appears to be a linear bar-like feature perpendicular to the radio axis just south of the core. This bar has a linear extent of almost 1 Mpc and has a steep spectral index below -1.5. The magnetic field lines in the bar are very ordered and oriented along its length; moreover, the percentage polarisation in this feature exceeds 50 per cent. The polarisation properties of the bar may be owing to a compression of the backflowing lobe material; however, the

linearity of the feature over 1 Mpc is intriguing. The lobe material appears to have met with an invisible discontinuity in the inter-galactic medium that runs over a distance of a mega-parsec.

One notices that the overall morphologies of the two inner lobes mimic the respective outer lobes: the northern inner and outer lobes are broad in contrast to the southern inner and outer lobes which are cylindrical. This indicates that the external medium on a given side may be affecting the inner and outer lobe morphologies similarly and the differences between the two sides may be attributed to differences in the ambient medium. Whether the hypothesised linear structure in the intergalactic medium to the south of the core causes the lobe asymmetries is unclear.

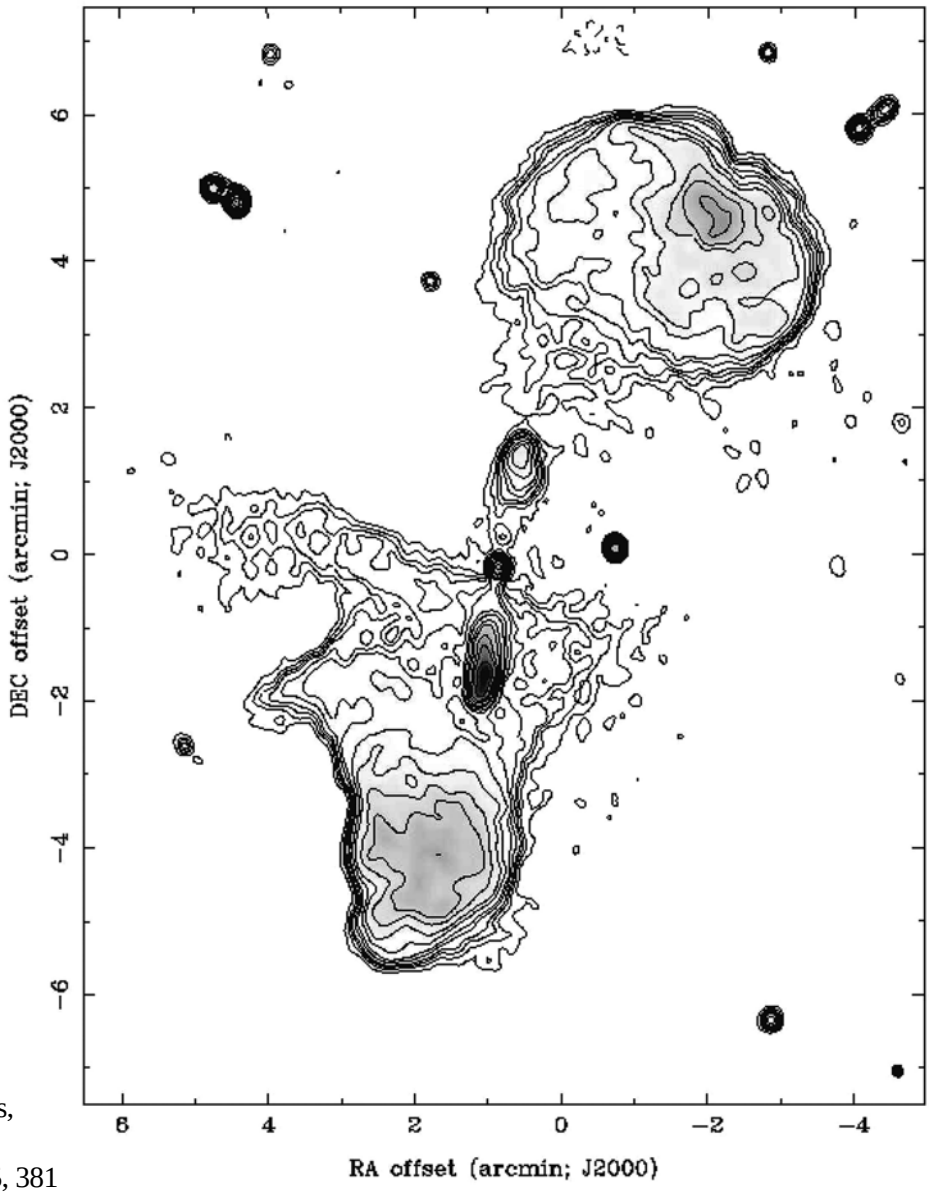


Figure 1: ATCA 20-cm image of B0114-476. The half-power beam size is shown in the lower right corner. Contours at 0.2 mJy/beam x (-1,1,2,3,4,6,8,12,16,24,32,48,96,128,196).

References

C. R. Kaiser, A. P. Schoenmakers, H. J. A. Rottgering, 2000, Mon. Not. Roy. Astron. Soc. 315, 381

K.-H. Mack, U. Klein, C.P. O'Dea, A.G. Willis, L. Saripalli, 1998 A&A, 329, 431

L. Saripalli, 1988 Ph.D Thesis, Indian Institute of Science, Bangalore, India.

A. P. Schoenmakers, A. G. de Bruyn, H. J. A. Rottgering, H. van der Lan & C. R. Kaiser, 2000, Mon. Not. Roy. Astron. Soc. 315, 371

R. Subrahmanyan, L. Saripalli, & R. W. Hunstead, 1996 MNRAS, 279, 257

Lakshmi Saripalli, Ravi Subrahmanyan (ATNF) and N. Udayshankar (Raman Research Institute, Bangalore)
(Lakshmi.Saripalli@atnf.csiro.au)

Millimetre-wave spectral line observing with Mopra

The history of the Mopra telescope and my inordinately long PhD are intertwined. In the past seven years Mopra has grown into a fine young telescope. Meanwhile, my PhD, after a long and difficult confinement, has become a description of the capabilities and potential of the Mopra telescope. I would now like to share what I have learned with other potential users.

My PhD has involved observing a large sample of dense cores in southern molecular clouds, in a variety of molecular transitions at millimetre wavelengths. I have used the observed line intensities to calculate molecular abundances and physical conditions in the sample of dense cores. This type of analysis requires careful intensity calibration of the Mopra observations. Consequently, calibration has formed a major part of my thesis.

Intensity Calibration of Mopra Data: Removing the Earth's atmosphere.

The specifics of intensity calibration can be found on the Mopra website at http://wwwnar.atnf.csiro.au/mopra/calibration/mm_calibration.html or http://newt.phys.unsw.edu.au/~ramesh/. Alternatively, I am very happy to send information about Mopra calibration on request to mhunt@atnf.csiro.au. In this article I would like to concentrate on the efficacy of the intensity calibration.

There seems to be a general belief that a millimetre site must be high enough to induce altitude sickness in the unfortunate observer if accurate line intensities are to be obtained. This is not true in the 3-mm band at which Mopra operates. The Earth's atmosphere absorbs radiation at millimetre wavelengths and this effect must be calibrated out, however it has proved possible at Mopra to formulate a calibration method that does this quite effectively. This method is a variation on the "chopper wheel" method commonly used to calibrate millimetre-wave telescopes (see Mopra web site for more information).

The calibration of Mopra data is a two step process:

1) The effect of atmospheric attenuation must be removed from the data. This is a most important step as atmospheric attenuation varies with air temperature, moisture content and zenith angle;

2) Secondly, the data must be tied to a known brightness temperature (intensity) scale. In this case the Mopra observations have been placed onto the SEST antenna temperature scale.

How effectively can this be done?

Figure 1 compares SEST observations to Mopra observations for the chosen primary calibrators Orion A and M 17. Figure 1a shows the Mopra observations before atmospheric calibration (Q_T) and Figure 1b shows the Mopra observations after atmospheric calibration (T_A'). The Mopra observations were made at a range of frequencies between 86 and 115 GHz during the period 1995 to 1998, in weather conditions that varied from clear to heavy cloud cover. The SEST observations are available on the SEST web site at http://www.ls.eso.org/lasilla/Telescopes/SEST/SEST.html.

The atmospheric calibration method clearly removes the attenuation effectively. The calibrated Mopra observations can then be placed on the SEST antenna temperature scale using the linear fit from Figure 1b. This relationship is

$$T_A^*(\mathrm{SEST}) = (1.62 \pm 0.06) T_A'(\mathrm{Mopra}). \qquad (1)$$

Note that this relationship is only valid for data collected prior to the resurfacing of the Mopra dish in 1999.

The correlation coefficient for equation (1) is $r^2 = 0.99$.

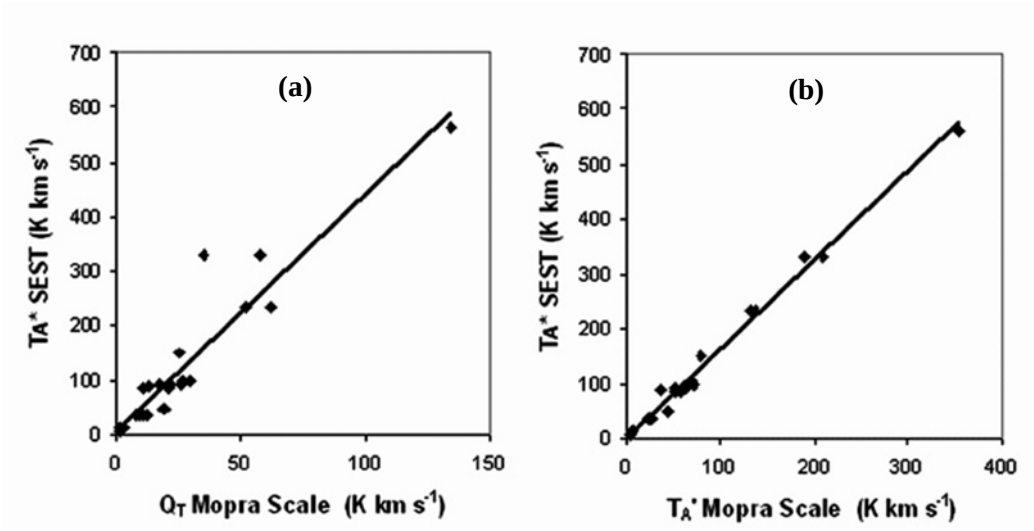


Figure 1: Comparison of SEST and Mopra data before and after calibration of the Mopra data. (a) SEST corrected antenna temperature (T_A*) plotted with Mopra peak antenna temperature before calibration (Q_T). The equation for the line of best fit is (T_A* SEST = 4.33(Q_T MOPRA) + 7.3 and the correlation coefficient is r^2 = 0.87. (b) SEST corrected antenna temperature (T_A*) plotted with corrected peak antenna temperature from Mopra (T_A') for the same data after calibration. The equation for the line of best fit is (T_A* SEST = 1.62(T_A' MOPRA) – 1.1 and the correlation coefficient is r^2 = 0.99.

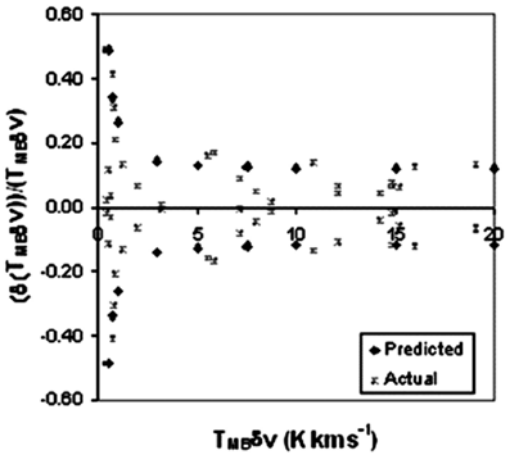


Figure 2: Relative uncertainties computed from equation (2) compared with actual values of relative uncertainties for calibrated Mopra data, plotted with integrated main-beam brightness temperature. The diamonds show the predicted values, while the crosses show the values obtained from repeated measurements.

Uncertainties in Mopra Data

The uncertainties in the Mopra data themselves have been calculated from repeated observations of a set of secondary calibrators. Once again the Mopra observations were collected during the period 1995 – 1998 in a variety of weather conditions.

The relative difference of each observation from the mean for that source (in terms of integrated brightness temperature), at that frequency, is shown in Figure 2. The observations are plotted against integrated main-beam brightness temperature (T_{MB}Dv) from calibrated Mopra observations. The uncertainties have been modelled as consisting of a flux dependent and a flux independent component as described in equation 2.

The sum of the two uncertainties can be represented by

$$\frac{\delta T_{MB}}{T_{MB}} = \left[\left(\frac{0.238}{T_{MB}}\right)^2 + 0.118^2\right]^{\frac{1}{2}} \quad (2)$$

where T_{MB} is the calibrated Mopra main-beam brightness temperature.

Figure 2 also shows the uncertainty values predicted by equation (2).

Calculating the uncertainties in this empirical way takes into account all sources of error, including those from the Gaussian fit to the spectral line. The flux-independent uncertainty of 11.8 per cent compares well with that of the SEST, which is estimated to be 10 per cent at 3-mm.

Doing Science with Mopra

Of course the proof of the pudding is in the eating. The rotation diagram in Figure 3 shows that Mopra can be used just as well as SEST to do science with 3-mm observations.

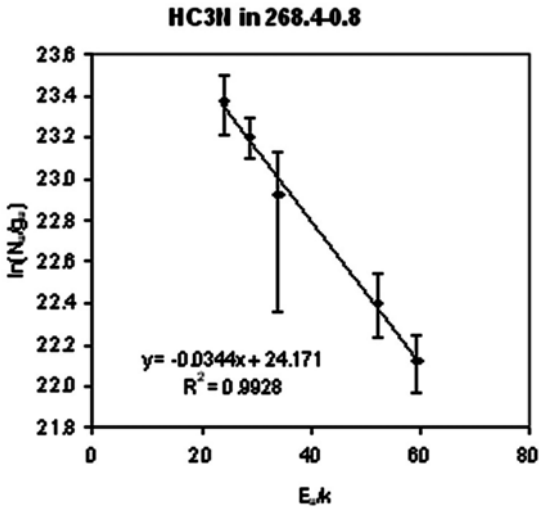


Figure 3: Rotation diagram for HC_3N in G268.4-0.8.

The rotation diagram (Figure 3) shows the number of molecules per statistical weight in the upper level of a transition plotted with the energy of the level above the ground state. The transitions shown, in order of increasing energy, are J=10-9, J=11-10, J=12-11, J=15-14 and J=16-15. The J=10-9 and J=12-11 are from Mopra whereas the others are from the SEST. The straight line relationship shows that the MOPRA and SEST observations have been successfully calibrated onto the same scale, as well as giving information about the excitation in the G268.4-0.8 molecular cloud.

The capacity of Mopra to provide accurate measurements of molecular line intensities makes it a valuable tool for investigating the interstellar medium and evolved stars, either used on its own or in conjunction with the SEST. The ready availability of Mopra to Australian astronomers and the low associated travel costs add to its value.

Studying the Interstellar Medium

Accurate measurements of molecular line intensities in several transitions of a molecule can be used to determine molecular abundances, temperatures and densities within molecular gas. There are a number of ways to obtain this information, all starting of course with the crucial business of accurate well-calibrated observations.

The kinetic temperature and molecular hydrogen column density can be obtained from observing CO and its isotopomers ^{13}CO, $C^{18}O$ and $C^{17}O$. The methods for doing this can be found in Rohlfs and Wilson (1996). The kinetic temperature is the temperature of the molecular hydrogen in a dense molecular cloud. CO can be assumed to be thermalised at the kinetic temperature. Other molecules may have different excitation temperatures, depending on the relative importance of their interaction with both the hydrogen molecules and the radiation field within the molecular cloud. (The radiation field at any frequency will have its own characteristic temperature as defined by Planck's law.)

A rotation diagram can be used to find the molecular abundance and excitation temperature of a molecule, if a straight line fit can be obtained. This type of local thermodynamic equilibrium (LTE) analysis can be used if the emission in the observed transitions is optically thin and if all transitions have the same excitation temperature (as defined by the level populations and the Maxwell-Boltzmann equation). For molecules such as HCN, HCO^+ and CS, which are usually optically thick, observations of ^{13}CO isotopomers can be used for the rotation diagram. A good reference for the use of the rotation diagram as an analytical tool can be found in Goldsmith and Langer (1999).

If the conditions of low optical depth and a single excitation temperature for all transitions are not met, a large velocity gradient (LVG) analysis can be used although this is a considerably more complex undertaking. An LVG analysis can give the kinetic temperature, excitation temperature, hydrogen spatial density and molecular abundance if at least four different transitions have been observed. I have some LVG analysis programs that I would be happy to provide to interested parties.

Combining Mopra with the SEST

The molecules HC_3N and OCS have three transitions within the range of Mopra, and CH_3OH has six. Mopra observations alone can be sufficient to determine physical conditions in these sources if combined with information on the kinetic temperature and molecular hydrogen column density from observations of CO. Molecular abundances can also be estimated from observations of a single molecule if the conditions for an LTE analysis are met. The optical depth is determined by observing an optically thin isotopomer of the molecule in question; however, observing a single transition does not give information on the excitation temperature of the molecule and so the accuracy of the abundance estimate cannot be known without further information.

The best strategy is to use Mopra to observe the available transitions of the molecules of interest and then augment these observations with SEST observations of some 2-mm and 1-mm transitions of the same molecule.

References

Goldsmith and Langer, 1999. ApJ. **517**, 209.
Rohlfs, K., and Wilson, T. L. 1996, Tools of Radio Astronomy, 2nd Edition. p. 386. Springer-Verlag, Berlin.

Maria Hunt, University of Western Sydney (mhunt@atnf.csiro.au)

Continued from page 1

First millimetre light for upgraded Australia Telescope

looking at a variety of astronomical sources and investigating the performance of the system. Some of the sources observed to date include the SiO masers in the circumstellar envelopes of the evolved stars VX Sgr, R Dor, and R Aqr, and HCO+ absorption against the nuclear continuum source in the radio galaxy Centaurus A. Many of the team's initial results are available on the web at http://www.atnf.csiro.au/mnrf/3mm_details.html

The prototype 3-mm receiving systems, installed on two of the Australia Telescope's six dishes, cover the frequency range 84 - 91 GHz. This current system will progressively be upgraded to the full array of six antennas with receivers covering a frequency range from 84 GHz to around 115 GHz. Routine millimetre observing is expected to start in mid-2003.

The chip at the heart of the new receiving system is an indium phosphide "monolithic microwave integrated circuit" (MMIC). This is one of several components being jointly developed by the ATNF and its sister CSIRO Division, CTIP (formerly the CSIRO Division of Radio Physics) under a special program established by former CSIRO Chief Executive, Malcolm McIntosh, to develop millimetre-wave integrated circuits for radio astronomy and telecommunications.

The upgrading of the Australia Telescope to work at millimetre wavelengths is funded by the Australian Federal Government under its Major National Research Facilities (MNRF) Program, and by CSIRO. More information on the MNRF projects underway at the ATNF is available on the web at http://www.atnf.csiro.au/mnrf/mnrf_outline.html

The MNRF science and engineering team
For further information contact Baerbel Koribalski (bkoribal@atnf.csiro.au)

An aerial view of the Australia Telescope Compact Array taken during millimetre test observations using antennas 3 and 4 (photo by Dave McConnell, ATNF).

Regular items

Square Kilometre Array Program

Since the last report there have been a number of interesting events in the Square Kilometre Array (SKA) program. First, we welcome Aaron Chippendale and George Warr in the roles of Support Engineer and Joint CSIRO/USyd Postdoc, respectively. Aaron, a former ATNF vacation scholar, will be involved in several projects but one of his first contributions will be to assist with the analysis and presentation of initial Western Australia site test data. George will be associated with a new integrated RF systems project and will also have a major role in student and professional outreach activities.

On the experimental front, the interference mitigation (IM) project continues to produce important new results. Using data from a recent ATCA observing session, Mike Kesteven and collaborators have been able to produce some excellent "before IM" and "after IM" images (see http://www.atnf.csiro.au/~mkesteve/INTMIT). The post-correlation IM approach used in the experiment is a niche for our group and we are working to explore the capabilities and limits of the technique. As an important bonus, IM may soon be offered routinely to ATCA and other telescope users.

In the antennas area, there has been significant progress in developing electromagnetic design and analysis tools for the Luneburg Lens; interesting current work is exploring the value of genetic algorithms in Lens optimisation. In a related development, the ATNF has recently signed a collaborative agreement with the Pushchino Radio Astronomy Observatory in Russia. The aim is to use a 0.9 m diameter Russian Lens to explore aspects of refracting antenna use in radio astronomy. While we are currently waiting on commercial contracts to be finalised, the demonstration lens may arrive in Australia in the first half of this year.

Other projects are also producing good results. Developments in the SKA site work lead us to expect that a first-round RFI survey in Western Australia will commence around the end of March. Progress has also been made in extending general investigations to possible sites in other parts of Australia. In the signal processing area, John Bunton has produced an interesting discussion document (framed as an ALMA memo) outlining the merits of FX correlators for contemporary and future arrays (see http://www.atnf.csiro.au/SKA/techdocs/ALMA_FX_Correlator.pdf) Work is also continuing on understanding the mechanisms needed to establish a radio-quiet reserve, both in the SKA context and as a more general global resource. SKA outreach has been a priority in recent months and, in response to more industry contact, we are beginning to field questions from a number of companies interested in collaborating in SKA R&D. A new booklet, aimed at the Australian technology community, is proving invaluable in summarising the engineering challenges in building the SKA.

The inaugural meeting of the Australian SKA Consortium Committee was held on Feb 9 and, on the day before the formal meeting, a one-day open symposium was held in Sydney. Details of the symposium, together with information about the aims of the Consortium, can be found at http://www.atnf.csiro.au/SKA/Aust_SKA_Symp_Home.html

Peter Hall
(Peter.Hall@atnf.csiro.au)

Australia Telescope Compact Array report

STAFF

Ben Reddall has taken a one year position at the South Pole providing engineering support for the DASI CMB telescope. Martin Oestreich has moved from Sydney to take on the role of Electronics Group Leader.

The Observatory welcomes new staff members who have joined the team.

- David Brodrick joined the Computer Group in late December and has started work on the ATOMS/ ACC project. He is also relieving John Giovannis from his system administrator duties for one day a week;
- Rudi Behrendt was appointed as Technician in the Electronics Group to work with Shaun James in the power / drives / communications area. Also appointed to the Electronics Group is Cliff Harvey as Technical Assistant, who is working with Alan Day in the Cryogenics Lab;
- Anni Reynolds is now with the Administration Group and is filling in the role of Administration Officer for Kylee Forbes while on maternity leave. Congratulations to Kylee and Simon on the birth of baby boy Jake. Margaret McFee will be with us for a period working as Administration Assistant / Receptionist. Thanks to Dianne Harris who departed the Observatory prior to Christmas after working in Administration / Reception for several months.

We farewell Leigh Panton who left in early February for a new job on the Gold Coast utilising skills in fibre optics work gained during many months of working on the Array in the “splicing caravan”. We wish Leigh all the best in her new endeavours.

From February 2001 Dave McConnell will be working from the Sydney office for approximately one year. Dave will retain the official role as OIC, undertaking management functions and TAC scheduling and will return to Narrabri on a monthly basis for a week at a time. Dave will also be making major inputs to the ATOMS/ACC project while in Sydney. Ron Beresford, who has recently taken on the role as Deputy OIC, will be managing the day to day operations of the Observatory.

OPERATIONS

Compact Array Usage

The chart below (Figure 1) outlines details of Compact Array usage for the 2000 October observing period (2000OCTT). The final term of the year usually extends for four months from September. In 2000 the observing periods were adjusted to account for the Sydney Olympic games and possible difficulties in purchasing air tickets to Australia during this time. The fraction of time spent in maintenance was higher than usual because of the two week MNRF installation period in November and December, and the shorter than usual term. The large “unallocated” period arose partly from the difficulty in scheduling the Christmas/New Year period.

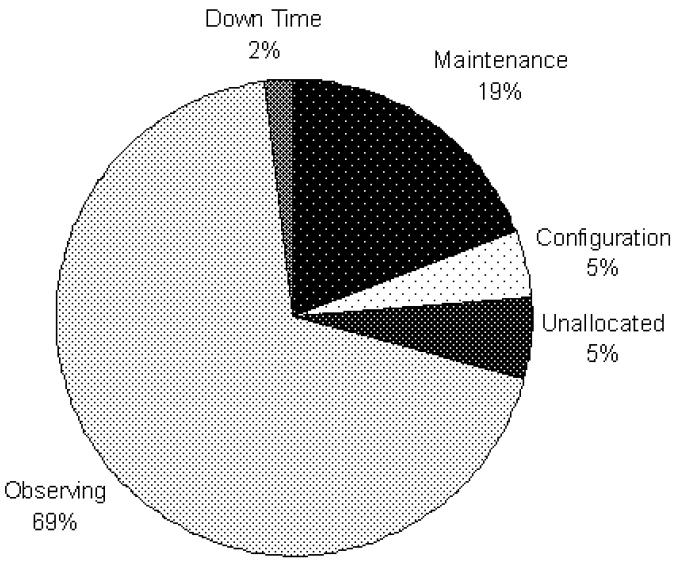


Figure 1: Compact Array Usage for 2000OCTT

		1996	1997	1998	1999	00JANT	00MAYT	00OCT
OBSERVING SUPPORT	Duty Astronomer	4.7	4.8	4.8	4.8	4.8	4.4	4.5
	Observatory Staff	4.7	4.7	5	4.7	5.0	4.9	4.0
	Observatory Staff (After hours)	4.8	4.8	4.8	4.7	5.0	4.8	5.0
DOCUMENTATION	ATCA Users' Guide	3.9	4.2	4.3	4.1	4.0	4.0	4.2
	On-line help	3.4	4	4.3	4.0	4.2	4.8	4.0
	Calibrator Information	N/A	N/A	N/A	3.4	4.7	4.7	4.0
TECHNICAL SERVICES	Imaging Facilities (Miriad etc)	4.2	4.3	4.3	4.2	4.3	4.0	N/A
	On-Line Processing	N/A	N/A	N/A	3.8	4.5	5.0	N/A
	Vaxes	4	3.7	4.2	3.8	3.9	4.3	5.0
	UNIX Computers	3.4	4	4.3	4.3	4.5	4.5	4.4
	PCs	2.8	3.6	4.5	4.1	4.0	4.3	4.5
	Library	4	4	4.5	4.4	4.8	4.8	5.0
OTHER (Remote Observing)	Tie Line	3.4	4.4	4.8	4.4	5.0	4.5	N/A
	Marsfield Services	4	3.3	4.0	4.8	5.0	N/A	N/A
	Marsfield Staff	5	3	5.0	N/A	N/A	5.0	N/A
	Remote Observing Web Page	4.3	4.5	4.8	4.5	5.0	4.0	N/A

Table 1 - ATCA User Feedback

USER FEEDBACK

The table above is compiled from observer assessments of the quality of support at the Observatory, with 5 being the highest score. The table compares figures for the years 1996-1999 and the three individual observing terms for 2000.

New Correlator interface

The VMS machine ATRIA, which has controlled the Compact Array correlator for a number of years, has been replaced by a new machine and software running under Linux. The users' interface to the correlator (still on a screen on the control room desk) has a more modern look – it is graphical! One of the great new features is the ability to view spectra from all baselines and polarisation products simultaneously. This is a wonderful thing, allowing rapid assessment of the system health, strength of interfering signals, etc.

COMPACT ARRAY UPGRADE

The highlight of the recent period was the first use of two receivers operating at 3.5-mm wavelength. This exciting event and some early results from the first Southern Hemisphere mm-wave interferometer are described elsewhere in this newsletter. Other activities in the upgrade program are mentioned here.

ATOMS/ACC

The project now has a good workforce with Scott Cunningham, David Brodrick, Dave McConnell and Mark Wieringa making contributions. Dave McConnell is making progress on the monitoring front (VMON): we can now successfully retrieve multiple monitor points using java and the pSOS ds driver, and get the data back onto the VMS machines. Scott is working on the CYCLE component, getting into the details of the event setups and environments. The problems with PCI bridges have been overcome with a new motherboard that provides 4 primary PCI slots. David Brodrick has tracked down and fixed a problem with the encoder interface. He is currently working on software to drive the new serial interface card that has been selected for use in all ACCs. Mark is continuing work on the legacy interface software and the integration with the VMS software.

Local Oscillator

A 14 GHz Local Oscillator was successfully supplied via optic fibre to antennas CA03 and CA04. The major bulk of fibre optic cabling was done sometimes under atrocious conditions – namely dust, heat, wet weather and flooding, mosquitos, spiders and snakes.

Leigh completed fibre optic cabling to all station posts with mains power available. Termination work in Screened room also completed. This was a massive effort by Leigh – approximately 708 fibre ends spliced.

Receivers

The triumphs with the new mm-wave receivers are described elsewhere, but it's worth mentioning the large local effort contributed to the actual installation and alignment. Martin's report of his group's efforts is

worth giving verbatim*: "Lot's of blood sweat, stainless steel bolts and Daisy machining involved"*. [Daisy = Alan Day, cryogenics technician, machinist extraordinaire, and one of several Narrabri people involved.] Since installation, the systems have been available for extensive performance tests. Most of these have been lead by Ravi Subrahamanyan who has worked very hard to characterise the antenna optics – alignment of primary and secondary reflectors and the receiver feeds.

OTHER OBSERVATORY WORK

Computing

John Giovannis has been working on upgrading the computer security on site, applying operating system patches and closing some security holes (with assistance from David Brodrick). This was prompted by a vacation student project to test our computer security. The preparations were successful and the students reported a secure system.

Scott Cunningham is finishing up his M.Sc. Thesis (on the Pulsar Machine) and continuing work on ATOMS.

Mark Wieringa has been dividing his time between AIPS++ bug fixes (quite a few uncovered lately) and ATOMS work.

Electronics

The Electronics Group has been very busy on a number of maintenance and renewal tasks, including: fitting new LNAs to the spare 6/3-cm receiver; adjustment of receiver turret cams; replacement of some crucial DC power supplies in the Correlator room; and numerous jobs at Mopra.

Engineering and Site Services

Visitors to the Observatory will have noticed the changes to the control building stairs. These stairs have long been known to not conform to building regulations – they were too steep and uneven. During the safety week in June last year Barry Parsons and Brian Wilkcockson rose to the challenge and proposed some improvements that could be made with minimal impact to the building and access to the upper level. Work commenced in December and will be completed early in 2001.

Other work in the engineering area includes the preparation of the final two "igloos" – cooling enclosures for the antenna cryogenics compressors. These will be installed in the next available maintenance period.

The grounds around the Compact Array tourist Visitors' Centre have been improved with a new wooden post and rail fence, which nicely finishes the new parking and roadway areas constructed last year.

Pulsar Backend

The last few months have seen outstanding progress with the Compact Array Pulsar Backend. This device will allow observations of pulsar profiles from the combined signal of all six antennas, giving a collecting area equivalent to a 54m dish. The Backend provides spectra with up to 1024 channels in each of 1024 points across the pulsar period. It operates at a number of bandwidths up to a maximum of 64MHz and can be used in any of the wavelength bands offered by the Compact Array. Martin Oestreich, Scott Cunningham and visitor Prof. A Deshpande from the Raman Research Institute, Bangalore, have forged ahead with the project and made some successful observations with a prototype operating on a single polarisation channel. Figure 2 shows the profile of pulsar J0437-4714 at 1410MHz.

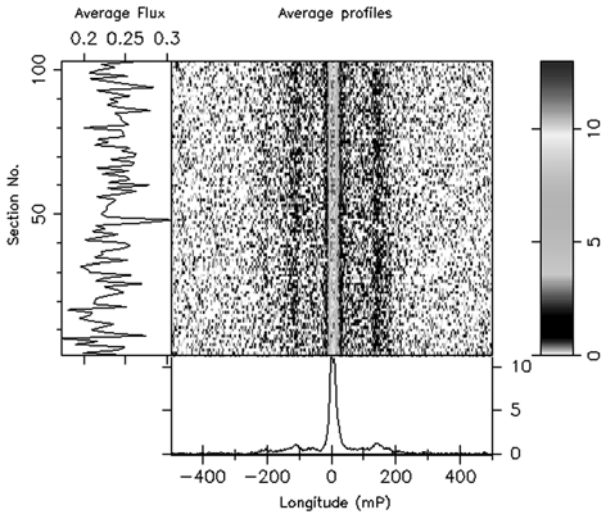


Figure 2: Profile of pulsar J0437-4714 at 1410MHz.

VISITORS CENTRE

There was a downturn in visitor numbers during September to October - possibly because of Olympics. November experienced another downturn because of flooding in the Namoi Valley.

WORK EXPERIENCE AT THE COMPACT ARRAY

Each year applications are received at the Compact Array from high school students Australia wide wishing to gain work experience positions. In the past it has been the practice to accept students one at a time in order to minimise the burden on the supervising staff.

During 2000 three applications arrived requesting a period in September and the question was asked, could we accommodate them? Although not immediately obvious it happened that the three applications were individual requests by students from the same school, Knox Grammar School, and each had acted independently without the other's knowledge. A quick check with the School's Science Master confirmed that the students were likely to get along with each other so the decision was made to accept their requests.

Anthony Smith, Robert Chapman and Roger Senior of Knox Grammar School preparing their equipment for observations

Realising that this was going to be quite a load on the observatory staff it was time to come up with a project that would give the students the experience they sought, be highly educational, and be able to be shared across different groups at the Observatory. After some deliberation it was decided that they could build their own radio telescope and the "RadioJove" project was selected.

"RadioJove" is a NASA project that is offered in America to school groups. The groups construct radio receivers and antenna systems from kits, conduct and record observations, analyse their data, and then share their results with other groups.

The three students, Robert Chapman, Anthony Smith and Roger Senior, were given fair warning of their project so they could gain an insight from information posted on the "RadioJove" web site (http://radiojove.gsfc.nasa.gov/). Five days is not a long period in order to complete the task.

On day one the students toured the Compact Array before familiarising themselves with the kit of parts and the tasks ahead. Day two saw Roger constructing the receiver while Robert and Anthony set about constructing a phased array dipole antenna system. Day three was spent aligning, tuning and testing the system.

Day four commenced at 3:00 am with Jupiter high in the sky. Hisses, crackles and plops were all recorded but unfortunately the noise of the recorder masked any results that may have been obtained. The rest of the day was spent determining system temperatures and tweaking.

On the final day the students were able to record directly to a lap top computer and the results were encouraging. Data analysis under the guidance of the OIC indicated that they had successfully measured the temperature of the Galactic Plane to within 30 per cent of the true figure. Not bad using such a simple system!

On the afternoon of the fifth day the students disassembled the equipment and readied it for a journey to Sydney where all students of Knox Grammar School can employ it. Feedback from the students indicated that they had enjoyed a very rewarding and educational experience whilst at the Paul Wild Observatory that would go a long way when they finally make decisions on their future careers.

Dave McConnell
Officer-in-Charge
(dmcconne@atnf.csiro.au)

The "RadioJove" receiver and tape recorder

Parkes Observatory report

SITE SERVICES

The last quarter has seen Site Services continuing the installation of irrigation systems and new landscaping at the Visitor's Centre. We are aiming to complete this project ready for an opening ceremony in mid March. Despite a month of temperatures above 40 degrees, the 400 seedlings planted out are doing well and the grounds work is attracting favourable comment.

Extensive slashing and mowing to reduce fire risk was carried out in early January. New storage facilities have been constructed in the Carpenter's shop. Fabrication of the Mark II batch of computer RFI cages is nearing completion, re-organisation of the electrician's workshop and office is under way and repairs are being undertaken to facilitate extensive painting works to be carried out later in the year.

During the short shut down at the end of January the Aerial cabin lift guide sheaves and cable drum bearings were replaced, UPS power was installed at the ME and the mains failure indicator installation was completed.

OPERATIONS

The October 2000 term has been an interesting one in terms of operations at Parkes.

The Multibeam Northern HIPASS, ZOA and Pulsar surveys continued as they approached completion. Quasi-daily timing observations of the millisecond pulsar J0437-4715, a project led by Willem van Straten of Swinburne University, are proceeding well and are achieving timing residuals of unprecedented accuracy. The GPS systems at the Observatory are being upgraded to ensure the best possible long-term time reference is available for timing projects such as this. A common-view GPS receiver is under construction and should be operational some time in the first half of 2001, allowing comparison of Observatory time direct with the NIST standard in Boulder Colarado, in addition to the comparisons with GPS/USNO time provided by the conventional GPS receivers.

There has been very little observing time lost due to equipment failure or wind. The figures for the October 2000 term (2/10/00 to 11/01/01) were 1.9 per cent of time lost to failures and 1.5 per cent lost to wind-stows. For the first time in many years, the observatory was shutdown in the Christmas to New Year period.

VISITORS CENTRE

The Visitors Centre has enjoyed unprecedented popularity since the release of the film "The Dish" in mid-October, 2000. All-time records for daily visitor numbers and revenue were frequently broken. Business activity has more than doubled compared to the same period previously. Similarly, the number of visitors rose to 34,000 from 15,000 in that time.

For several weeks, countless media interviews, with television and radio appearances kept many on site busy. Some of the old hands (all retired) were inundated with media requests, all wanting to know how true to the events the film's depiction was. At times it seemed they weren't retired at all.

Arousal of public interest and awareness was always expected. It is interesting to note that a significant fraction of recent visitors claim that they "had never heard of the Parkes Radio Telescope before" - in contrast with previous years when many visitors claimed that they had "been meaning to call in for years".

On December 18, an Apollo 11 re-union was organised in Old Parliament House, Canberra. It was the first time that everyone who was involved in the Australian side of the mission was able to get together and reminisce. It was organised by the CSIRO, NASA and Working Dog Productions. With the imminent release of the Video in the next few months, and the launch of the "The Dish" in the USA and Europe, interest in the Observatory is sure to remain high. A report on the Parkes Observatory's support of the Apollo 11 mission can be accessed at the folowing URL:

http://www.parkes.atnf.csiro.au/apollo11/

The long-running audio-visual multiprojector slide show was replaced in August 2000 by a completely reworked show, "The Invisible Universe", made by Australian Business Theatre with help from ATNF staff including Raymond Haynes, Rick Twardy, Helen Sim and John Reynolds.

The influx of visitor interest was smoothly handled in the enlarged visitors centre, completed in August 2000. Finishing touches to the grounds, and alteration to content of displays took a little longer. Labour, organisation and instruction skills for the grounds improvement were the product of a work-for-the-dole scheme, itself an outcome from approaching the Parkes Shire Council for assistance.

John Reynolds (Officer-in-Charge), John Sarkissian, and Rick Twardy
(John.Reynolds@atnf.csiro.au)

Time Assignment information

We would like to advise users of some changes to the available observing facilities during 2001/2002.

ATNF Support for Mopra Observations

Under an agreement with the University of New South Wales (UNSW), for six weeks each year the Mopra telescope is operated with a "National Facility" level of support. During this period, observing support is provided by UNSW. For a further six weeks each year, Mopra is available for the sole use of UNSW staff and students. The total UNSW period of 12 weeks is normally scheduled during the Australian winter months.

Please note that from January 2001 onwards, support for Mopra will be restricted to the observing periods supported by UNSW and additional times for VLBI observations. Mopra applications should be submitted for the May terms (May to August) only.

22 GHz observations at the Compact Array

The development of 12-mm receivers is a key component in the high-frequency upgrade of the Australia Telescope Compact Array. Two prototype 12-mm receivers were installed on antennas 3 and 4 in November 1999. A major milestone was reached in December 1999 when the first 12-mm image was obtained from observations taken with these two receivers and a third receiver built for the Mopra telescope.

Until further notice a limited amount of time is available for science and test observations with the Compact Array with the two 12-mm prototype receivers. We request that all 22 GHz proposals include an ATNF staff collaborator.

The operation of the Compact Array at 12-mm will be greatly improved with the final 12-mm receivers for all six antennas. These are due for completion in 2002.

New ATCA Configurations

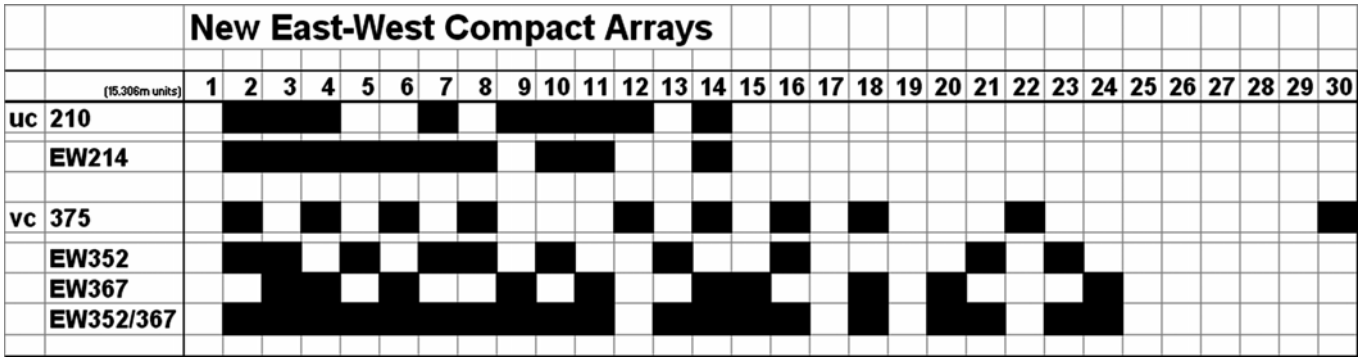
From September 2001, several new east-west and north-south stations will become available. These will provide additional array configurations with baseline spacings less than 400m. If requested, the 6 km antenna can be added to any of the arrays.

In 2001SEPT the new configuration EW 352 will be offered for the first time. This configuration combined with the new configuration EW 367 provides almost uniform coverage for spacings between 30 and 370 m. These two arrays will be offered in alternate terms. Figure 1 shows the baseline spacings for the new east-west configurations.

Full details on availability of the new configurations is given in the Guide to Observations with the Compact Array, http://www.atnf.csiro.au/observers/docs/ca_obs_guide.

Jessica Chapman, Dave McConnell
National Facility Support
(jchapman@atnf.csiro.au, dmcconne@atnf.csiro.au)

Figure 1: Baseline spacings for the new compact east-west configurations. The numbers at the top are in units of 15.306 m. Baselines using the 6 km antenna are not shown.



ATNF publications list

A publication list for papers which include ATNF data is available on the web at http://www.atnf.csiro.au/research/publications/. Please email any corrections or additions to Christine van der Leeuw (christine.vanderleeuw@atnf.csiro.au). Full publications lists are given in the ATNF annual reports. This list includes published refereed articles and conference papers including ATNF data, compiled since the October 2000 newsletter. Papers including one or more ATNF authors are indicated by an asterisk.

*BELL, E.F. & DE BLOK, W.J.G. “The bimodal spiral galaxy surface brightness distribution”. MNRAS, 311, 668 (2000).
*BELL, J.F. “Studying pulsars with the SKA and other new facilities” in Pulsars 2000 and beyond, IAU Colloquium 177, ASP conference series. 711-716 (2000).
*BELL, J. F., VAN KERKWIJK, M. H., KASPI, V. M., & KULKARNI, S. R. “The temperature and cooling age of the white dwarf companion to the millisecond pulsar PSR B1855+09”. In Pulsars 2000 and beyond, IAU Colloquium 177, Bonn 1999, ASP conference series. 633-634 (2000).
BERENDSEN, S.G.H., FENDER, R., KUULKERS, E., HEISE, J. & VANDERKLIS, M. “Simultaneous radio and X-ray observations of Galactic Centre low-mass X-ray binaries”. MNRAS, 318, 599-605 (2000).
*BRIGGS, F.H., BELL, J.F. & KESTEVEN, M.J. “Removing radio interference from contaminated astronomical spectra using an independent reference signal and closure relations”. AJ, 120, 3351-3361 (2000).
BROOKS, K.J. “An investigation of the Carina Nebula”. PhD thesis, University of New South Wales, August (2000)
*CAMILO, F., KASPI, V.M., LYNE, A.G., MANCHESTER, R.N., BELL, J.F., D’AMICO, N., McKAY, N.P.F. & CRAWFORD, F. “Discovery of two high-magnetic field radio pulsars”. ApJ, 541, 367-373 (2000).
*CHARTAS, G., MARSHALL, H.L., WORRALL, D., BIRKINSHAW, M., CRESITELLO-DITTMAR, M., CUI, W., GHOSH, K.K., HARRIS, E., HOOPER, E.J., JAUNCEY, D.L., KIM, W., LOVELL, J., MATHUR, S., SCHWARTZ, D.A., TINGAY, S.J. et al. “The Chandra X-Ray Observatory resolves the X-ray morphology and spectra of a jet in PKS 0 637-752”. ApJ, 542, 655-666 (2000).
COTE, S., CARIGNAN, C. & FREEMAN, K.C. “The various kinematics of dwarf irregular galaxies in nearby groups and their dark matter distributions”. AJ, 120, 3027-3059 (2000).
*DICKEL, J.R., MILNE, D.K. & STROM, R.G. “Radio emission from the composite supernova remnant G326.3-1.8 (MSH 15-56)”. ApJ, 543, 840-849 (2000).
*DICKEL, J.R., STROM, R.G. & MILNE, D.K. “Radio Structure of the supernova remnant G315.4-2.3 (MSH 14-63)”. AJ, 546, 447-454 (2001).

*ELLINGSON, S. W., BUNTON, J. D. & BELL, J. F. “Cancellation of GLONASS signals from radio astronomy data” In Astronomical Telescopes and Instrumentation Ð radio telescope, SPIE conference 4015, Munich, March 2000 400-407 (2000).
*FOMALONT, E., HIRABAYASHI, H., MURATA, Y., KOBAYASHI, H., INOUE, M., BURKE, B., DEWDNEY, P., GURVITS, L., JAUNCEY, D., McCULLOCH, P., PRESTON, R., HORIUCHI, S., LOVELL, J., MOELLENBROCK, P., EDWARDS, P. et al. “VSOP survey I: description and participation”. In: Astrophysical phenomena revealed by space VLBI: proceedings of the VSOP Symposium, January 2000, 167-176 (2000).
*FORSTER, J. R. & CASWELL, J.L. “Radio continuum emission at OH and H2O maser sites”. ApJ, 530, 371-386 (2000).
GAENSLER, B.M., DICKEL, J.R. & GREEN, A.J. “G328.4+0.2: a large and luminous Crab-like supernova remnant’’. ApJ, 542, 380-385 (2000).
GAENSLER, B.M., STAPPERS, B.W., FRAIL, D.A., MOFFETT, D.A., JOHNSTON, S. & CHATTERJEE, S. “Limits on radio emission from pulsar wind nebulae”. MNRAS, 318, 58-66 (2000).
*GEORGAKAKIS, A., FORBES, D.A. & NORRIS, R.P. “Cold gas and star formation in a merging galaxy sequence”. MNRAS, 318, 124-138 (2000).
GIBSON, B.K., GIROUX, M.L., PENTON, S.V., PUTMAN, M.E., STOCKE, J.T. & SHULL, J.M. “Metal abundances in the Magellanic Stream”. AJ, 120, 1830-1840 (2000).
*GORDON, S., KORIBALSKI, B., HOUGHTON, S. & JONES, K. “Guide to Taurus-2 Fabry-Perot data reduction” MNRAS, 315, 248-262 (2000).
*GWINN, C.R., CARLSON, B., DOUGHERTY, S., DEL RIZZO, D., REYNOLDS, J.E., JAUNCEY, D.L. et al. “Noise reduction in the presence of strong spectrally-isolated signals”. In: Astrophysical phenomena revealed by space VLBI: proceedings of the VSOP Symposium, January 2000, 289-292 (2000).
*HAN, J.L. & MANCHESTER, R.N. “The shape of pulsar radio beams”. MNRAS, 320, L35-L39 (2001).
HEARNSHAW, J.B.; BOND; KORIBALSKI, B.S.; et al “Photometry of Pulsating Stars in the Magellanic Clouds as Observed in the MOA Project” “The Impact of Large-Scale Surveys on Pulsating Star Research” IAU Col 176 203 (2000).
*HILL, T.L., HEISLER, C.A., NORRIS, R.P., REYNOLDS, J.E. & HUNSTEAD, R.W. “Starburst or Seyfert? Adding a radio and far-infrared perspective to the investigation of activity in composite galaxies”. AJ, 121, 128-139 (2001).
*HJELLMING, R.M., RUPEN, M.P., HUNSTEAD, R.W., CAMPBELL-WILSON, D., MIODUSZEWSKI, A.J., GAENSLER, B.M., SMITH, D.A., SAULT, R.J., FENDER, R.P., SPENCER, R.E., DE LA FORCE, C.J., RICHARDS, A.M.S., GARRINGTON, S.T.,TRUSHKIN, S.A., GHIGO, F.D., WALTMAN, E.B. & McCOLLOUGH, M. “Light curves and radio structure for the September 1999 transient event in V4641 Sagittarii’’. ApJ, 544, 977-992 (2001).
HOPKINS, A., GEORGAKAKIS, A., CRAM, L., AFONSO, J. & MOBASHER, B. “Microjansky radio sources in DC 0107-46 (Abell 2877)”. ApJS, 128, 469-478 (2000).
*HOPKINS, A., WINDHORST, R., CRAM, L. & EKERS, R. “What will the next generation radio telescope detect at 1.4 GHz?”. ExpA, 10, 419-437 (2000).
*KASPI, V. M. , LYNE, A. G. , MANCHESTER, R. N. , CRAWFORD, F. , CAMILO, F. , BELL, J. F. , D’AMICO, N. , STAIRS, I. H. , McKAY, N. P. F. , MORRIS, D. J. & POSSENTI, A. “Discovery of a young radio pulsar in a relativistic binary orbit”. ApJ, 543, 321-327 (2000).
*KILBORN, V.A., STAVELEY-SMITH, L., MARQUARDING, M., WEBSTER, R.L., MALIN, D.F., BANKS, G.D., BHATHAL, R., de BLOK, W.J.G., BOYCE, P.J., DISNEY, M.J., DRINKWATER, M.J., EKERS, R.D., FREEMAN, K.C., GIBSON, B.K., HENNING, P.A., JERJEN, H., KNEZEK, P.M., KORIBALSKI, B., MINCHIN, R.F., MOULD, J.R., OOSTERLOO, T., PRICE, R.M., PUTMAN, M.E., RYDER, S.D., SADLER, E.M., STEWART, I., STOOTMAN, F. & WRIGHT, A.E. “An Extragalactic HI Cloud with No Optical Counterpart”. AJ, 120, 1342-1350 (2000).
*LAZIO, T.J.W., FEY, A.L., JAUNCEY, D.L. ET AL . “The extreme scattering event toward PKS 1741-038: VLBI images”. ApJ, 534, 706-717 (2000).
*LISTER, M.L., PINER, B.G. & TINGAY, S. “The impact of minimal ground antenna coverage on the VSOP survey”. In: Astrophysical phenomena revealed by space VLBI: proceedings of the VSOP Symposium, January 2000, 189-192 (2000).
*LISTER, M.L., PRESTON, R.A., PINER, B.G. & TINGAY, S.J. “The Pearson-Readhead survey at 43 GHz”. In: Astrophysical phenomena revealed by space VLBI: proceedings of the VSOP Symposium, January 2000, 203-206 (2000).

*LOVELL, J. “Difwrap: a graphical user interface for error analysis in difmap”. In: Astrophysical phenomena revealed by space VLBI: proceedings of the VSOP Symposium, January 2000, 301-304 (2000).
*LOVELL, J.E.J., HORIUCHI, S., MOELLENBROCK, G., HIRABAYASHI, H., FOMALONT, E., DODSON, R., DOUGHERTY, S., EDWARDS, P., FREY, S., GURVITS, L., LISTER, M., MURPHY, D., PARAGI, Z., PINER, G., SCOTT, W., SHEN, Z.-Q. et al. “VSOP survey III: statistical results”. In: Astrophysical phenomena revealed by space VLBI: proceedings of the VSOP Symposium, January 2000, 183-188 (2000).
*LOVELL, J.E.J., TINGAY, S.J., PINER, B.G., JAUNCEY, D.L., PRESTON, R.A., MURPHY, D.W., McCULLOCH, P.M., COSTA, M.E., NICOLSON, G., HIRABAYASHI, H., REYNOLDS, J.E., TZIOUMIS, A.K., JONES, D.L., LISTER, M.L., MEIER, D.L. et al. “VSOP and ATCA observations of PKS 0637-752”. In: Astrophysical phenomena revealed by space VLBI: proceedings of the VSOP Symposium, January 2000, 215-218 (2000).
*MOELLENBROCK, G.A., LOVELL, J., HORIUCHI, S., FOMALONT, E., HIRABAYASHI, H., DODSON, R., DOUGHERTY, S., EDWARDS, P., FREY S., GURVITS, L., LISTER, M., MURPHY, D., PARAGI, Z., PINER, G., SCOTT, W. et al. “VSOP survey II: reduction methods”. In: Astrophysical phenomena revealed by space VLBI: proceedings of the VSOP Symposium, January 2000, 177-182 (2000).
*PRANDONI, I., GREGORINI, L., PARMA, P., DE RUITER, H.R., VETTOLANI, G., WIERINGA, M.H. & EKERS, R.D. “The ATESP radio survey I. Survey description, observations and data reduction”. A&AS, 146, 31-39 (2000).
*PRANDONI, I., GREGORINI, L., PARMA, P., DE RUITER, H.R., VETTOLANI, G., WIERINGA, M.H. & EKERS, R.D. “The ATESP radio survey II. The source catalogue”. A&AS, 146, 41-55 (2000).
*PRESTON, R.A., LISTER, M.L., TINGAY, S.J., PINER, B.G., MURPHY, D.W., MEIER, D.L., PEARSON, T.J., READHEAD, A.C.S., HIRABAYASHI, H., KOBAYASHI, H. & INOUE, M. “The Pearson-Readhead survey from space”. In: Astrophysical phenomena revealed by space VLBI: proceedings of the VSOP Symposium, January 2000, 199-202 (2000).
PUTMAN, M.E. “The Magellanic system’s interactive formations”. PASA, 17, 1-5 (2000).
*RAYNER, D.P., NORRIS, R.P., & SAULT, R.J. “Radio circular polarization of active galaxies”. MNRAS, 319, 484-496 (2000).
RUGHOOPUTH, S.D.D.V., OODIT, S., PERSAND, S., GOLAP, K. & SOMANAH, R. “A new tool for handling astronomical images”. Astrophys & Space Sci., 273, 245-256 (2000).
*SCHWARTZ, D.A., MARSHALL, H.L., LOVELL, J.E.J., PINER, B.G., TINGAY, S.J., BIRKINSHAW, M., CHARTAS, G., ELVIS, M., FEIGELSON, E.D., GHOSH, K.K., HARRIS, D.E., HIRABAYASHI, H., HOOPER. E.J., JAUNCEY, D.L., LANZETTA, K.M. et al. “Chandra discovery of a 100 kiloparsec X-ray jet in PKS 0637-752”. ApJ, 540, L69-L72 (2000).
*SEVENSTER, M. & CHAPMAN, J.M. “First detection of 1720 MHz OH maser emission from a a post-AGB star”. ApJL, 546, L119-L122 (2001).
*TINGAY, S .J. & MURPHY, D.W. “Estimates of the free-free optical depth toward the subparsec-scale radio source in Centaurus A”. ApJ, 546, 210-215 (2001).
VAN DE STEENE, G.C., VAN HOOF, P.A.M, & WOOD, P.R. “Near-infrared and Br gamma observations of post-AGB stars”. A&A, 362, 984-1003 (2000).
VAN DE STEENE, G.C. , VAN HOOF, P.A.M. & WOOD, P.R. “Near infra-red and Br-gamma observations of post-AGB stars”. A&A, 362, 984-1003 (2000).
*VEEN, P.M. & WIERINGA, M.H. “Upper limits to the radio-fluxes of the Wolf-Rayet stars WR 46 (WN3p) and WR 50 (WC7+abs)”. A&A, 363, 1026-1028 (2000).
*VERON-CETTY, M.-P., WOLTJER, L., .STAVELEY-SMITH, L. & EKERS, R.D. “The nature of powerful compact radio galaxies”. A&A, 362, 426-434 (2000).
*WANG, N., MANCHESTER, R.N., PACE, R.T., BAILES, M., KASPI, V.M., STAPPERS, B.W. & LYNE, A.G. “Glitches in southern pulsars”. MNRAS, 317, 843-860 (2000).
*WILLIAMS, R.E., BAUM, S., NORRIS, R.P., et al “The Hubble Deep Field South: Formulation of the Observing Campaign” AJ, 120, 2735 (2000).

Contact information

CSIRO Australia Telescope National Facility

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

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

Parkes Observatory

PO Box 276
Parkes NSW 2870
Australia

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

Paul Wild Observatory, Narrabri

Locked Bag 194
Narrabri NSW 2390
Australia

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

Mopra Observatory, Coonabarabran

See Paul Wild Observatory

ATNF News On-line

http://www.atnf.csiro.au/news/newsletter