ATNF News

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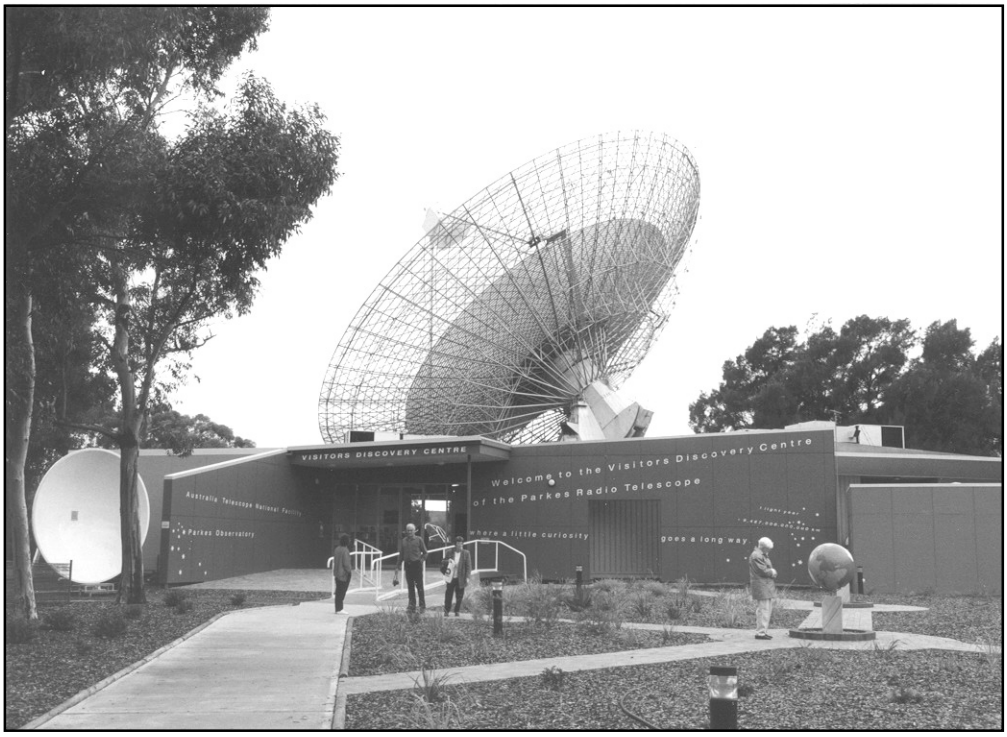
FEATURES IN THIS ISSUE

New Visitors Centre for the Parkes Observatory



The Visitors Centre at the Parkes Observatory

The long-awaited official opening of the upgraded Parkes Visitors Centre and grounds took place on 24 March 2001, attended by a striking assortment of local and visiting dignitaries, and with CSIRO's new Chief Executive Dr Geoff Garrett performing the honours.

The new Centre has double the floor-space of the old, with greatly inceased space for exhibits, shop and audio-visuals (and for staff!). The entrance to the Centre complements newly landscaped grounds to present a welcoming and attractive face to visitors. The building design features a dedicated audio-visual theatre / lecture room specifically designed to encourage visits from school groups, especially from the neighbouring regions. Many new and upgraded displays have already been introduced, mainly through the efforts of Helen Sim and Lucia Bromley-Gambaro. Fabulous video footage of the construction of the telescope and of the Apollo 11 mission, extracted from deep within the archives, is a great new feature. Improving and adding to the exhibits is the focus for activity in the short-term future, with emphasis on more interactive displays a priority.

The Centre now boasts two new audio-visual shows. The first was produced for the ATNF by the Australian Business Theatre, using the same multiple slide projector format as the original, and was premiered in August

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Editorial

Welcome to the June 2001 issue of the ATNF News. We have a great variety of articles and items in this issue and hope you enjoy the read, either online at *http://www.atnf.csiro.au/news/newsletter* or in the printed version. We remind readers that if you change address and still wish to receive the printed edition, to fill out our change of address and feedback form on the web at *http://www.atnf.csiro.au/news/newsletter/survey.*

As always, contributions to the ATNF News are welcome, either ATNF-related science articles or news items from around the organisation. Contributions can be submitted to *newsletter@atnf.csiro.au*. The next issue will be available in October 2001.

The ATNF News production team – Steven Tingay, Jo Houldsworth and Jessica Chapman (newsletter@atnf.csiro.au)

Contents

News items

Letter to the Editor

I feel duty-bound to point out that, contrary to the statement in the otherwise excellent lead article on the 3-mm first-light at the Australia Telescope Compact Array in the 2001 February newsletter, this is not the first 3-mm interferometer in the Southern Hemisphere. I believe that this honour belongs to a portable instrument built by John Archer and Norman Labrum in order to observe solar limb intensity profiles during the solar eclipse of 1976 October 23, which produced totality over a path sweeping through Victoria and southern NSW. The resulting profile was published in Proc ASA 3, 256, 1978, and I assume there is further material in John Archer's Sydney University Ph.D. thesis (1977). There is a photo of Labrum with the interferometer on page 173 of the book "Solar Radiophysics" (McLean and Labrum, Cambridge University Press, 1985). Labrum also carried out single-dish 3-mm observations of the eclipse with a 1-m telescope from Stawell in the Grampians in Victoria, and my resources don't say whether the portable interferometer was located there or somewhere else.

Norman Labrum with the 3-mm interferometer. Reproduced with the permission of Cambridge University Press, from "Solar Radiophysics", 1985, edited by Don McLean and Norman Labrum (Cambridge University Press).

I hasten to add that I had no involvement in this experiment (I am, after all, far too young), but I do remember the eclipse as I was batting low in the order for an ANU 5th or 6th grade cricket team in the suburbs south of Canberra at the time and my otherwise brief innings was interrupted by an early and lengthy tea while we waited for the partial eclipse (there) to pass.

Stephen White
University of Maryland
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Post-doctoral appointment

In March we welcomed Diah Setia Gunawan. Diah is visiting the ATNF for one year as a post-doctoral fellow under a CSIRO-Indonesian fellowship scheme, established with the aim of building relationships between young Indonesian scientists and the CSIRO.

Diah obtained her first degree in astronomy from the Institute of Technology in Bandung, Indonesia. She recently completed her PhD at the University of Groningen, on "Colliding Winds in Wolf Rayet Binaries", under the supervision of Ger de Bruyn and Karel van der Hucht. At the ATNF she is working on radio observations of the stellar winds from massive stars and will be using the Compact Array for millimetre observations of southern Wolf Rayet stars.

Jessica Chapman
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Australia's Citation Laureates

A symposium on "Honouring excellence in Australian research" was hosted by the Institute for Scientific Information (ISI) at the Australian Academy of Sciences on 26 March 2001.

In a recent study by the ISI, citation rates were analysed for all papers in the ISI database, for the years 1981 to 1998. This study selected the 200 most highly cited papers for each year in each of 22 broad categories. It then identified Australian authors who had published more than six high-impact papers in science-related disciplines during this period. This study identified 33 top Australian scientists with multiple high-impact papers. Each of these scientists received a "Citation Laureate" award at the ISI symposium.

Remarkably, nine of the thirty-three top scientists identified in this study are astronomers. The high fraction of astronomers is a tribute to the excellence of astronomical research in Australia. The honoured astronomers were Prof Michael Bessell, Dr Matthew Colless, Prof Michael Dopita, Prof Ken Freeman, Prof Jeremy Mould, and Dr Bruce Peterson from the Research School of Astronomy & Astrophysics at the Australian National University; Dr Richard Manchester of the Australia Telescope National Facility; Prof Warrick Couch of the University of New South Wales; and Dr Richard Hunstead of the University of Sydney.

It was indeed a pleasure to be recognised in this way. Not surprisingly, all of my 11 high-impact papers were written with colleagues, and I sincerely thank them for their many and varied contributions to the work reported in these (and other!) papers. It is also reflects the excellent support from the CSIRO and especially from my colleagues and friends at the ATNF which makes this such a great place to work.

ISI invited the Laureates and various other "science" people to dinner at University House on the evening before the symposium. This was pleasant and it was interesting to meet and talk with some of the people from other fields. There were five Laureates from CSIRO. The symposium was held in the Shine Dome of the Australian Academy of Science. Talks were given by Mr Michael Tansey (President, Thomson Scientific & Healthcare), Honorable Warren Entsch, MP (Parliamentary Secretary to the Minister for Industry, Science and Resources) and Dr Geoff Garrett (CSIRO Chief Executive). Mr Jeff Clovis (Director, International Product Support, ISI) gave a global perspective of publishing trends and discussed their citation system and its scope. For the future, they see electronic publication becoming more and more important and are hoping to set up an ADS-like retrieval system for the whole of science. Linda Butler (Research School of Social Sciences, ANU), who has made several studies of citations and research performance in Australia, discussed the national perspective. Prof Graham Farquhar (Research School of Biological Sciences, ANU), who topped the poll with 22 high-impact papers, gave a talk from the perspective of a researcher. Mr Adam Klein (Vice President, Asia-Pacific Market Development, ISI) spoke on honouring reseach in Australia. Mr Michael Tansey then presented each of us with an engraved pewter plate to commemorate the occasion.

Dick Manchester
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New online tools at the ATCA

Two new online tools are now available at the ATCA, aimed at helping users prepare proposals and observing schedules. A web page which provides access to extensive information on ATCA calibration sources is available at *http://wwwnar.atnf.csiro.au/calibrators*. Another web page provides an online sensitivity calculator for the most commonly used observation modes at the ATCA and is available at *http://www.atnf.csiro.au/observers/docs/at_sens*.

Steven Tingay
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First 2-GHz spectrum from InP digitiser and wideband correlator

Recently we obtained the first 2-GHz bandwidth (4 Gigasample/s) spectrum from the new indium phosphide heterojunction bipolar transisitor digitiser and wideband correlator.

The digitiser is based around a high speed integrated circuit built using indium phosphide (InP) heterojunction bipolar transistor (HBT) technology as part of the Special Executive Project -"Advanced InP Monolithic Microwave Integrated Circuits for Radioastronomy and Telecommunications". This project also yielded a range of high performance low noise amplifiers, mixers, analogue multipliers and other circuits in both indium phosphide high electron mobility transistor (HEMT) and HBT processes. The InP HBT technology offers transistors with an intrinsic cutoff frequency of 70 GHz combined with good across-chip device matching and modest levels of integration and so was well suited for realising a medium complexity circuit such as a digitiser. The digitiser performs three-level quantisation with integrated 1-4 demultiplexers to slow the output data rate to manageable speeds. The total power consumption of the 740 transistor integrated circuit is 1.6 W. On-wafer testing demonstrated correct large signal operation of the device to at least 10 GHz clock rate. Our current correlator allows us to use the device in-system to a maximum clock rate of 4 GHz.

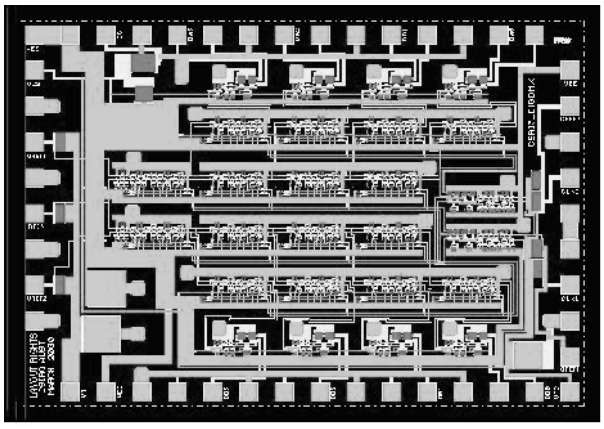

Figure 1: Indium phosphide heterojunction bipolar transistor digitiser integrated circuit (3.2mm x 2.2 mm).

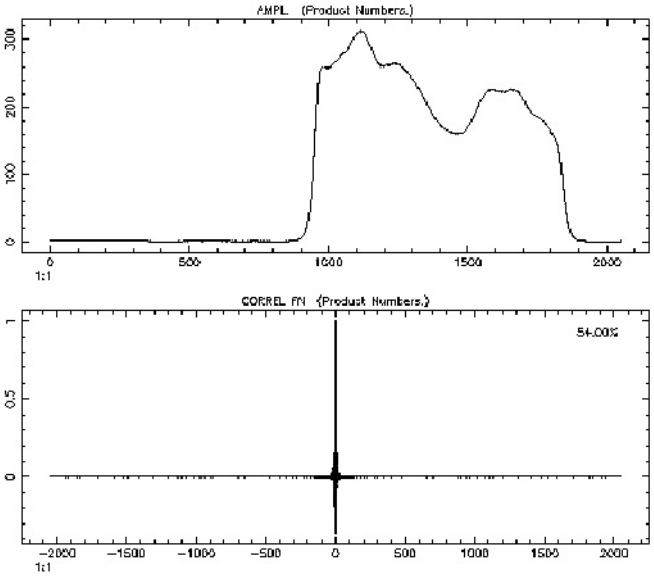

Figure 2: Spectrum of a 950-1800 MHz bandpass filter taken with the ATNF indium phosphide digitiser and wideband correlator. The sample rate is 4.0 Gigasamples/s (2.0 GHz BW) with 2048 channels.

The wideband correlator is an upgraded version of the 1-GHz bandwidth correlator delivered to the Swedish-ESO Submillimitre Telescope last year. The maximum equivalent sample rate is now 4 Gigasamples/s with up to 2048 frequency channels achieved by using a number of 128 MHz NASA SERC correlator chips in parallel combined with ATNF designed buffer and accumulator boards.

The illustrated spectrum (Figure 2) shows the digitiser and correlator processing a 950-1800 MHz band from a laboratory noise source and bandpass filter with a total bandwidth of 2.0 GHz (4.0 Gigasamples/s sample rate) and 2048 channels. The ripple across the band is due to the noise source and filter. This result represents a significant increase in correlator system performance.

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news

VLBI polarisation workshop

A one-day workshop on VLBI polarisation was held at ATNF Marsfield on 26 February 2001. VLBI polarimetry is routinely carried out using NRAO's (National Radio Astronomy Observatory) Very Long Baseline Array facility and, occasionally, using the European VLBI Network. The purpose of this workshop was two-fold: to show observers currently observing with the VLBA how to do polarisation calibration and to get the user community prepared for polarisation studies once this facility becomes available on the Australian Long Baseline Array (LBA).

As a tracer of asymmetry and anisotropy (most commonly magnetic fields and scattering phenomena) polarimetry yields unique information on the physical state and the geometry of astronomical sources and the intervening material. In particular, for extragalactic sources, the milliarcsecond resolution obtained with VLBI provides information on a scale of parsecs, making it possible to study the innermost accessible regions of radio jets of active galactic nuclei.

The morning session was devoted to a discussion of underlying theory followed by a series of short presentations outlining new science enabled by this technique. In the afternoon, the entire VLBI data calibration path was discussed with the additional steps needed for polarisation calibration highlighted and discussed in detail. The workshop concluded with a look at the possibility of doing VLBI polarimetry with the Australian Long Baseline Array (LBA). While there are significant obstacles, this looks possible in the not too distant future.

A postscript document containing most of the talks given during the workshop is available at *http://www.atnf.csiro.au/~rojha/lbap.html*. Information on the LBA can be found at *http://www.atnf.csiro.au/vlbi*.

Roopesh Ojha
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Major National Research Facilities proposal submitted

Earlier this year the government announced, as part of a new innovation statement, a new "Major National Research Facilities" program. Following a great deal of discussion at the ATNF and other astronomical institutions, and on expert advice, the decision was made to combine the two highest priorities of the Australian astronomical community into one proposal for MNRF funding. These priorities, as identified by the Australian astronomical community in the report "Beyond 2000: The Way Ahead" (to be published in June 2001), are additional access to the optical/infrared telescopes of the Gemini project and development of the Square Kilometre Array – the next generation radio-telescope. This MNRF proposal was submitted to AusIndustry on 11 May. A major side-effect of the combination of priorities is that the astronomical institutions in Australia are probably more closely coupled now than they have ever been before, and so in a real sense this proposal is a united force to move all of Australian astronomy forward.

The specific aims of the proposal are to:

1) Increase Australia's share in the International Gemini Telescopes from 5% to 10%. The way in which we propose to buy in to this increased share is by not just sending money offshore, but by using the MNRF funding to build new instruments for Gemini. So this not only gets Australian astronomers a bigger share of Gemini observing time, but it also (a) improves the capabilities of the Gemini telescopes, and (b) advertises Australia's expertise in instrument-building, hopefully leading to more contracts to build instruments for other international telescopes;

2) Develop enabling technologies for the Square Kilometre Array (SKA). The way in which we plan to do this not only develops the technologies which will be necessary for the construction of the SKA, but also (a) does so by enhancing our existing radio-telescopes such as the Australia Telescope Compact Array, and (b) reinforces Australia's bid as the prime location to host the SKA.

Ray Norris
ATNF Deputy Director
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Australia Telescope User's Committee report

The first meeting of the Australia Telescope User's Committee for 2001 was held at ATNF headquarters on 19 - 20 March, 2001. There were 11 members in attendance and the meeting was chaired by Dr Anne Green.

Appreciation was expressed to the retiring members for their valuable contributions to ATUC: Ms Bignall (student member), Dr Chapman, Dr Jauncey, Dr Lineweaver, Mr Muller (student member).

In the open session (19 March), the meeting received status reports from each facility and the AIPS++ project. Several new possible development projects were outlined, and Mr Andrew Wright described the plans for revamping the ATNF web site. The Business session (20 March) addressed 16 issues from the Director's Reply to the previous ATUC Report. Major points of note:

1) ATUC reiterated its desire that the Parkes and Narrabri Officers-in-Charge be given every assistance in providing the observing schedules one month before the start of each term. Some practical suggestions were made;

2) ATUC proposed to organise an open forum for discussion of the MNRF-II proposal. See below;

3) The new sensitivity calculators (*http://www.atnf.csiro.au/observers/docs/at_sens/*) and calibrator web pages (*http://www.narrabri.atnf.csiro.au/calibrators*) were welcomed. The committee requested more information on a proposal for an online raw-data archive of Australia Telescope Compact Array data. ATUC recommended some hands-on training in AIPS++ be provided during the synthesis workshop in September 2001;

4) Now that some of the 3-mm receivers are installed at the ATCA, the question of implementing weather-dependent schedules for the telescope needs to be decided. ATUC intends to allocate some time for discussion of this important issue at the next (open) session of the User's Committee;

5) Scientific priorities were assigned to several projects, including multibeam systems for Parkes and polarimetry for the Long Baseline Array. A total of 11 recommendations were made in the report presented to the Director at the end of the meeting. The full agenda and report is on the web, along with those for previous meetings, at *http://www.atnf.csiro.au/overview/atuc*.

On 11 March 2001 the government released the guidelines for a new round of proposals for Major National Research Facilities funding, with the submission date set for 11 May. The ATNF will submit a proposal, in partnership with several Universities (see Ray Norris' article elsewhere in this issue).

ATUC organised a half-day meeting for the user community to give input to the proposal. This was held on 9 April, with participants from a broad cross-section of user institutions. Several proposals were presented to the meeting and feedback on each was collated. The results of the feedback, and the overall direction and strategy of the proposal were discussed in the second half of the meeting. A report was given to the panel charged with preparation of the proposal. Most of the presentations given, the feedback results and the email discussions leading up to the meeting are available on the web at *http://www.atnf.csiro.au/mnrf/round2*.

Anne Green, ATUC Chair
and Vince McIntyre, ATUC Secretary
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Vince.McIntyre@atnf.csiro.au)

Symposia and workshops – July to October 2001

The ATNF astronomical synthesis imaging workshop will be held at the Australia Telescope Compact Array, Narrabri, on 24 - 28 September 2001. Registration, accommodation, and program information are available on the web at *http://www.atnf.csiro.au/synthesis.*

An astrobiology workshop will be held at Macquarie University on 12 - 13 July 2001. Details can be found at *http://www.aao.gov.au/local/www/jab/workshop.html.*

Steven Tingay
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news

2001/2002 CSIRO Summer Vacation Scholarship Program

Applications are invited for the CSIRO Summer Vacation Scholarship Program, with participating divisions being the Australia Telescope National Facility and Telecommunications and Industrial Physics (at both the Marsfield and Lindfield sites). Scholarships are available for 10 to 12 working weeks between December 2001 and February 2002. The stipend is A$450 per week. The program is held for students who have completed at least three years of undergraduate studies in physics, mathematics, computer science, electrical engineering or closely related subjects. Each student works on a research project under the supervision of a research engineer or scientist.

The program also includes a series of introductory lectures on the work of each of the organisations involved, and regular weekly talks given by staff members. At the beginning of the program the students are given a special welcome lunch and are taken on a tour of the CSIRO Marsfield and Lindfield laboratories. A highlight of the program is the Observatory Trip where the students are given the opportunity to work on a project of their own choosing, for four days, at either the Parkes or Narrabri Observatories.

Applications forms are available on the web at the address *http://www.atnf.csiro.au/educate/summer_vacation/summer_info_page.html.* and are also available from university student or careers coordinators.

Applications should be sent in writing on the forms (sections one and two) and should include a curriculum vitae. The closing date for applications is 17 August 2001.

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

ATNF graduate student program

It is a pleasure to welcome the following PhD students who have recently joined the ATNF/Universities co-supervision program:
Sebastian Gurovich: "Investigating the Baryonic Tully-Fisher relationship"
Supervisors: Ken Freeman, Helmut Jerjen (RSAA, ANU) and Erwin de Blok (ATNF);
Minh Huynh: "Constraining the star formation history of galaxies in the Hubble Deep Field South region with sensitive radio data"
Supervisors: Carole Jackson (RSAA, ANU) and Ray Norris (ATNF);
Daniel Mitchell: "Interference Mitigation in Radio Astronomy"
Supervisors: Lawrence Cram (University of Sydney) and Bob Sault (ATNF);
Meryl Waugh: "Galaxy Populations, Dynamics and Evolution of the Fornax Cluster"
Supervisors: Rachel Webster (University of Melbourne), Michael Drinkwater (University of Melbourne) and Ron Ekers (ATNF).

Congratulations to the following ex-students who obtained their doctorates or masters within in the last year:

- Shaun Amy (PhD University of Sydney) "A Radio Study of Selected regions in the Magellanic Clouds"
- Kate Brooks (PhD University of New South Wales) "An investigation of the Carina Nebula"
- Virginia Kilborn (PhD University of Melbourne) "The Large-Scale Distribution of Neutral Hydrogen in the Local Universe"
- Stacy Mader (PhD University of Wollongong) "Giant Herbig-Haro flows: Identification and Consequences"
- Malte Marquarding (MSc University of Melbourne) "Luminosity Functions of Late-type Galaxies"
- Mary Putman (PhD Research School of Astronomy & Astrophysics, Australian National University) "Mapping the Galaxy's Neutral Hydrogen Halo"
- Dave Rayner (PhD University of Tasmania) "Circular polarization of active galaxies"
- Jagmit Sandhu (PhD California Institute of Technology) - the high precision timing of millisecond pulsars
- Niven Tasker (PhD Macquarie University) "Identifications from the PMN Southern Survey"

Theses for these students are mostly available at the ATNF library in Marsfield. Please advise of any additions to the above list. Finally, the 2001 ATNF student symposium was very successfully organised by Melanie Johnston-Hollitt, Emma Ryan, Daniel Mitchell and Erik Muller; see the report elsewhere in this issue.

Lister Staveley-Smith
Graduate Student Coordinator (Lister.Staveley-Smith@atnf.csiro.au)

The ATNF Student Symposium 2001

The annual ATNF Student Symposium was held on 4 April 2001 in the Lecture Theatre at ATNF Headquarters, Marsfield. The Student Symposium is an informal opportunity for ATNF affiliated students to showcase their research to the staff and other students of the ATNF. The 2001 symposium presentations ranged over a wide variety of topics, with talks given by:

Hayley Bignall - Radio Intraday Variability and "Revolutionary Synthesis";
Tracy Getts - OH/IR Stars and the Galactic Centre Distance;
Sebastian Gurovich - Baryonic Tully Fisher Relation from HIPASS galaxies;
Melanie Johnston-Hollitt - An Interpolated All Sky Rotation Measure Map;
Dion Lewis - Pulsar glitches at Parkes and Mt. Pleasant.
Daniel Mitchell - Interferometric Decorrelation of Low to Mid Earth Orbiting Satellite Signals;
Erik Muller - ^{12}CO emission from the Magellanic Bridge; and
Vivienne Wheaton - Continuing Investigation of Radio Emission from SNR 1987A;

The Symposium was well attended by both students and staff and the presentations were of high quality. The talks were followed by a luxurious chicken and champagne lunch and conversation on the downstairs conference room patio. The organisers would like to thank all who attended, both students and staff, for contributing to the research efforts of the younger generation of astronomers. Particular thanks must be extended to the canteen staff for providing a wonderful lunch and to Lister Staveley-Smith for his assistance and advice in making the 2001 ATNF Student symposium such a success.

ATNF Student Symposium 2001 Organisers:
Melanie Johnston-Hollitt, Emma Ryan, Daniel Mitchell and Erik Muller
(mjohnsto@atnf.csiro.au)

Another successful apprentice from ATNF Narrabri

Leigh Panton joined the ATNF Narrabri electronics group as an apprentice in April 1999. As Leigh had already completed part of her Electronics Trade Certificate while working for a local business, she continued studying part time at Tamworth TAFE College, finishing in December 2000.

Leigh played an important role as part of the group responsible for the installation of the Compact Array's new optical fibre systems. Over 34 kilometres of new fibre has been installed underground and Leigh has completed and tested 564 fusion splices! Fusion splicing is a tedious job requiring meticulous cleaning, care and patience. Thanks to Leigh's work, most of the station posts on the East-West track now have fibre installed and preliminary testing of these new systems has begun.

According to ATNF policy, Leigh knew that there would not be a long-term position available for her at the Compact Array after completing her apprenticeship, so she was very happy when she secured a job in the fibre industry on the Gold Coast, earlier this year. Leigh took advantage of the opportunities available while with the ATNF and learned the right skills to achieve a consistently high standard of work with minimal supervision. Leigh became valuable to industry and found it easy move on when the time came.

Good luck Leigh and congratulations.

Daron Brooke
(Daron.Brooke@atnf.csiro.au)

Leigh splicing fibres at the new patch panel in the screened room.

Articles

Hydroxyl masers studied with the enhanced Parkes spectrometer

The Multibeam correlator at Parkes was designed primarily to be the spectrometer for the 21-cm 13-beam receiver, and yield 1024-channel spectra for 2 polarisations and 13 beams (or 2048 channel spectra for 2 polarisations and 7 beams). With small changes, it can be made a powerful spectrometer for single-beam receivers, for which it can provide up to 16384 channels in each of 2 polarisations.

The observations shown here were taken with this new correlator capability on 2 May 2001, during a study of hydroxyl masers in our Galaxy. Two of the masing transitions lie at 6035 and 6030 MHz and can thus be studied together in a single 8-MHz bandpass. However, the maser emission features are very narrow in frequency (or equivalent radial velocity), requiring study with resolution of about 1 kHz, and thus if an 8-MHz bandpass is used, we need 8000 channels to achieve adequate spectral resolution.

Observing the lines simultaneously within a single band has the obvious advantage of halving the observing time, and has the additional advantage that the calibration is precisely the same for the observations of both transitions. Although the central portion of the band is not of great interest in these observations, a single wide band is preferable to much narrower (1-MHz) individual bands since filters for the latter would have a more rapid fluctuation of gain across the bands, and lead to more uncertainty in the baselines of the spectra.

Figure 1 shows the spectrum obtained towards a southern Galactic maser site in a massive star forming region, 300.969+1.148. In this observation, the correlator was configured to provide 8192 channels across 8 MHz in each sense of circular polarisation. This was adequate for the present objectives, but 16384 channels could have been obtained if needed. The slight ripple across the band has not been corrected for in this initial spectrum. Emission from the 6035-MHz transition can be seen near channel 2000, and weaker emission, from the 6030-MHz transition can be seen near channel 6600. The immense detail in the spectrum can be seen in Figure 2 where the spectral regions of greatest interest are shown on an expanded scale.

The 6035-MHz emission had been discovered in previous observations at Parkes, and it is clear that features of the Left hand circular polarisation (LHCP) are slightly displaced in velocity from those of Right hand circular polarisation (RHCP). Strictly, this is a displacement in frequency, which in many situations is conveniently displayed as an equivalent Doppler velocity. The displacement can be interpreted as splitting due to the Zeeman effect caused by a magnetic field in the emitting region. The separation of the two polarisations is proportional to the field strength, and in this case implies a magnetic field of -5 milliGauss (with the negative sign denoting a direction towards us).

Note that, in addition to the strong emission, Figure 2 shows that there is weaker emission at both higher and lower velocities. These weaker regions of emission also show the LHCP component shifted to less negative velocity than its RHCP counterpart, by an amount that likewise implies a magnetic field of -5 mG. Looking now

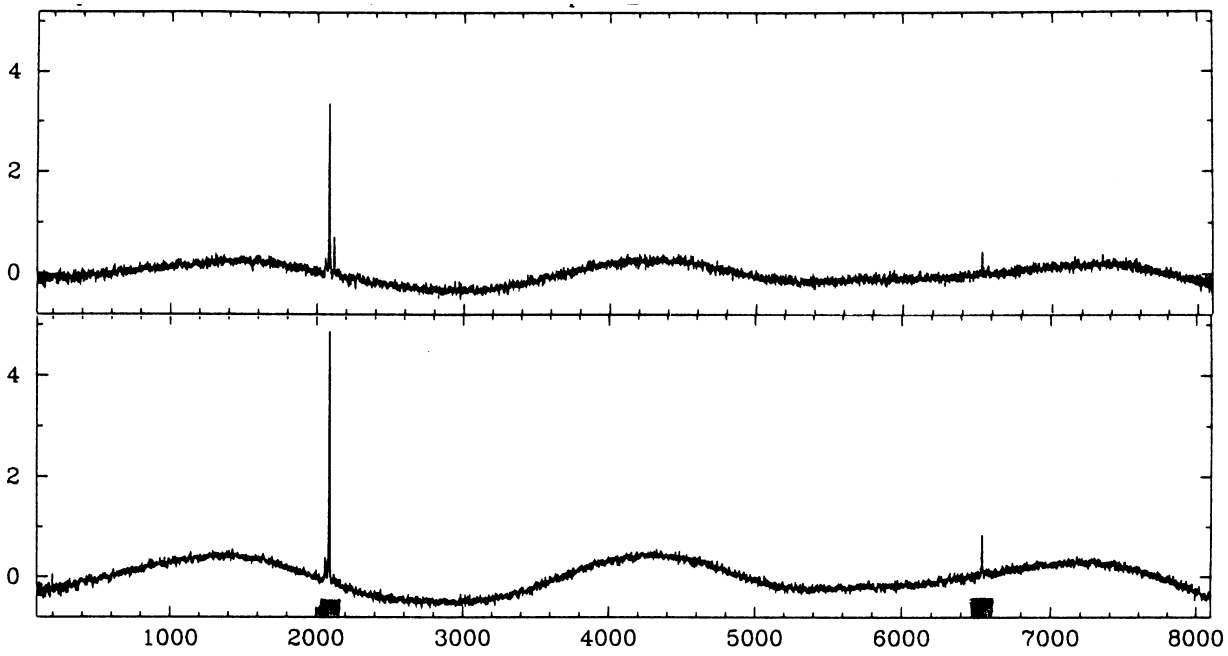

Figure 1 above: Full spectrum of more than 8000 channels spanning nearly 8 MHz between 6037 and 6029 MHz. Right hand circular polarisation (RHCP) is plotted above left hand circular polarisation (LHCP). There has been no attempt to remove the slow instrumental ripple from this initial spectrum. The feaures of interest are the narrow maser emission spikes near channels 2000 and 6600.

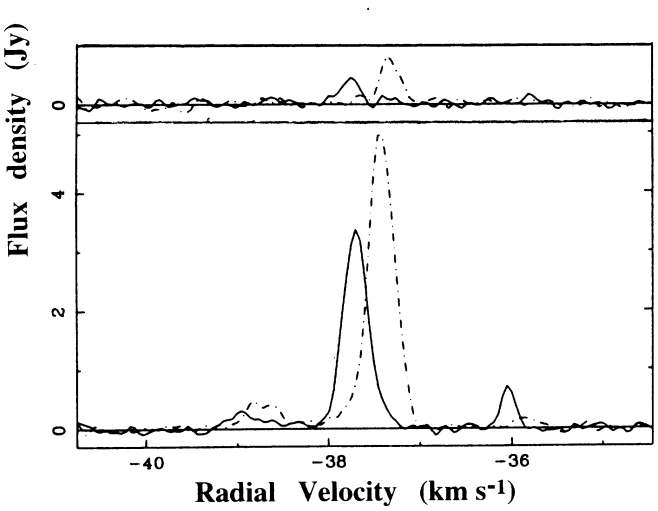

Figure 2 left: Lower panel is a small portion of the spectrum near channel 2000 (at 6035 MHz) greatly expanded, and the upper panel is a small portion near channel 6600 (at 6030 MHz) greatly expanded. RHCP solid line; LHCP broken line overlaid.

at the 6030-MHz spectrum, shown in the upper panel of Figure 2, we see that the emission is much weaker and, indeed, it had not been detected prior to these observations. It shows emission approximately one-seventh as strong as the 6035-MHz transition. Close inspection shows that the mean velocity of the prominent RHCP and LHCP Zeeman pair is the same as for the 6035-MHz transition, but the separation is slightly larger. This is exactly as expected if the emission arises from the same region (same magnetic field), since the Lande g-factor (the Zeeman splitting factor) is calculated to be 1.4 times larger for the 6030-MHz transition than for the 6035-MHz transition.

At present, coincidence of the two transitions in velocity has been confirmed, and it will in future be possible to assess the spatial coincidence with high accuracy using the Long Baseline Array of the AT, which now has a similar spectral capability of observing both transitions at high spectral resolution within a single band and thereby allows the precise alignment of maps at the two transitions.

What can we learn from observations of the present kind? Firstly, the new data for the 6030-MHz transition provide valuable corroboration of the magnetic field inferred from the 6035-MHz transition. Furthermore, the occurrence of maser

species at both these transitions can be compared with theoretical expectations of conditions under which such masing can arise. The observed coincidence of both maser species is in agreement with some maser pump models and not with others, and thus is a discriminant between pumping models. Additionally, given a correct pumping model, the observed relative strengths of the maser emission can be used to infer the physical conditions that must be present, such as the density, velocity field, temperature, and incident infra-red radiation field.

The source shown here is one of several hundred maser sites of this type that are present in the Galactic plane, and each one is believed to pinpoint a very young massive star that cannot yet be seen because it is surrounded by an obscuring cocoon of dust and molecules (including the masing molecules). Thus the masers are able to trace the physical conditions (density, temperature and magnetic field) in the cloud of gas from which the star has just formed, and can yield valuable insights into the process of the formation of a massive star. In the theoretical models of star formation, the influence of magnetic fields is often ignored in order to make the problem tractable, but observations such as these can indicate whether the magnitude of the field is so large that their omission from the models is a fatal flaw.

The implementation of new spectrometer modes with the Multibeam correlator now enables it to surpass all of the common configurations available on the earlier "Parkes AT correlator". As foreshadowed in the AT Development Plans webpage *(http://www.atnf.csiro.au/overview/future)*, further enhancements to the older correlator are now unlikely to be pursued since most objectives can be better achieved by the Multibeam correlator.

In addition to the new spectrometer capability, the observations described here also made use of the recently completed Parkes RF/IF conversion system (a part of the MNRF upgrade), which simplifies operation, allows increased flexibility in spectral line mode, and performed flawlessly.

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New Visitors Centre for the Parkes Observatory

2000. This show retains the extremely high quality visual material and the illusion of animation exploited so successfully in the original, but has been completely re-shot and rewritten to bring it up to date. Response to this show has been excellent, both in feedback and in increased attendance. After the formal opening ceremony in March 2001, the Visitors Centre premiered a new three-dimension virtual reality tour of the Solar System entitled "The Sun – What a Star". This show, produced by the Swinburne University of Technology's Astrophysics & Supercomputing group, complements the more traditional program of the slide show very nicely, and is also proving to be a crowd-pleaser. Special thanks go to Matthew Bailes of Swinburne for assisting the Observatory in making this show available. Thanks also to Raymond Haynes for assistance with the new slide show.

With greatly increased visitor numbers in recent times, it is now quite common to see visitors arriving after the usual closing time. Latecomers are able not only to view the telescope itself, now an icon of Australian science, but to roam the grounds and inspect a number of new and novel outdoor exhibits. A ¾-metre Earth globe, oriented to show Australia at the top of the world, when in direct sunlight duplicates the daylight regions on the Earth's surface at that moment – a very simple yet illuminating demonstration. Nearby is a precision sundial which tells the correct standard time all year with an accuracy that surprises many. Both exhibits were designed by Rick Twardy, Manager of the Visitors Discovery Centre. Two huge "whispering dishes" (3.5-m diameter) have been retrieved from obscurity at Marsfield and are now deployed with striking effect in the grounds, proving very popular (and independent of direct solar illumination!). With the dishes almost 50 metres apart, whispered communication provides a vivid and tangible demonstration of the basic concepts embodied so successfully in the parabolic shape of the Parkes dish itself.

The new Centre was officially opened by the Chief Executive of CSIRO, Dr Geoff Garrett, on 24 March 2001. In a novel opening ceremony, a small radio dish detected the microwave energy generated from congratulatory handshakes between Dr Geoff

Garrett, Prof Ron Ekers (Director of the ATNF), Mr Robert Wilson (Mayor of Parkes), and Mr Roy Billing (well known for his role of the Mayor of Parkes in "The Dish"), causing a flag to be raised, officially opening the facility. This demonstration elegantly captured the energy, teamwork, and focus required to bring the new Vistors Discovery Centre to fruition. Also present at the ceremony were Tony Blane MLA, member for Dubbo, Jack Scoble, former Mayor of Parkes) and Dr Russell Cannon, Chair of the ATNF Steering Committee.

Other VIP guests included members of the ATNF Steering Committee, Geoff Garrett's family, Lyndsay James of CSIRO Corporate Property, Jim Caddaye of Collins Caddaye Architects and the builder Tim McCabe. The threatening rain fortunately held off long enough for guests to escape into the Centre for a cup of tea and to inspect the interior. Many pictures from the opening are available from the Parkes website *http://www.parkes.atnf.csiro.au*.

The original Visitors Centre at the Observatory was opened in February 1969. The facility was significantly upgraded in 1982 under the operation of CSIRO's Science Communication Unit but was subsequently transferred to the Division of Radiophysics (which then operated the Observatory) around 1985. During the 1980s, several events such as Halley's Comet, supernova 1987A, and Voyager 2 at Neptune captured public interest in astronomy. In 1994, Marcus Price, newly appointed as the Parkes Officer-in-Charge proposed a significant upgrade of the Visitors Centre, aimed at doubling its existing size. The project was finally completed in August 2000, and was funded jointly by the CSIRO corporate capital works programme and by ATNF. Assistance for the landscaping of the grounds was provided by Parkes Council and Tony Lawler, MHR through a Commonwealth Government employment programme.

The opening of the Discovery Centre is well timed: with the recent exposure from the film "The Dish" and related publicity, our visitor numbers for the last eight months have more than doubled. We expect around 110,000 visitors for the calendar year 2001.

It is a pleasure to work in the refreshed and re-invigorated Visitors Discovery Centre, and to count the approving faces of visitors. We aim to present the wonder of astronomy to anyone who is interested and to highlight the important contributions to radio astronomy that the CSIRO has made through the ATNF and its predecessor the Division of Radiophysics. Our vision is that the new Visitors Discovery Centre will stand as an attraction in its own right, a destination which will attract visitors from near and far. The new Visitors Centre is a credit to those involved in the project and speaks loudly and clearly of CSIRO's commitment to inform and educate the public of our achievements in the field of radio astronomy.

"A little curiosity goes a long way ... and leads to great things!"

Rick Twardy
Manager, Parkes Visitors Discovery Centre
(Rick.Twardy@atnf.csiro.au)

Guests at the opening of the new Parkes Visitors Centre watching the 3D virtual reality tour of the Solar System.

Observations of galactic X-ray binaries with the ATCA

Over the past five years or so we have been observing galactic X-ray binaries sources extensively with the Australia Telescope Compact Array (ATCA). In such systems the radio emission arises via the synchrotron process, and is associated with the steady or transient production of jet-like outflows, small-scale analogs of the giant radio jets associated with Active Galactic Nuclei. As the only modern, large interferometer in the Southern Hemisphere, with its superb polarisation capabilities, observations with the ATCA have allowed investigations of some crucial aspects of these relativistic jets, and their coupling to the accretion flow.

The relationship between jets and black hole X-ray 'states'

Accreting black holes in binary systems switch between different "states", characterised by their X-ray spectral and timing properties (e.g. Nowak 1995). The four persistent systems known in our galaxy spend most of their time in the "low/hard" state, which has a nonthermal power-law spectrum up to ~100 keV. It was already known that two of these systems, Cyg X-1 and GX 339-4, produced approximately steady radio emission when in this state. However, in 1998 GX 339-4 entered the "high/soft" state, in which the X-ray spectrum is dominated by thermal emission (presumably from a hot accretion disc) for a year. Using observations with the ATCA and the Molonglo Observatory Synthesis Telescope (MOST) we were able to establish that throughout this phase the radio emission was "quenched" by a factor of greater than 25 (Figure 1, Fender et al. 1999; Corbel et al. 2000). Motivated by these observations, we have now established that in the low/hard state black holes always seem to produce an approximately continuous partially self-absorbed jet (resulting in a flat radio spectrum), and

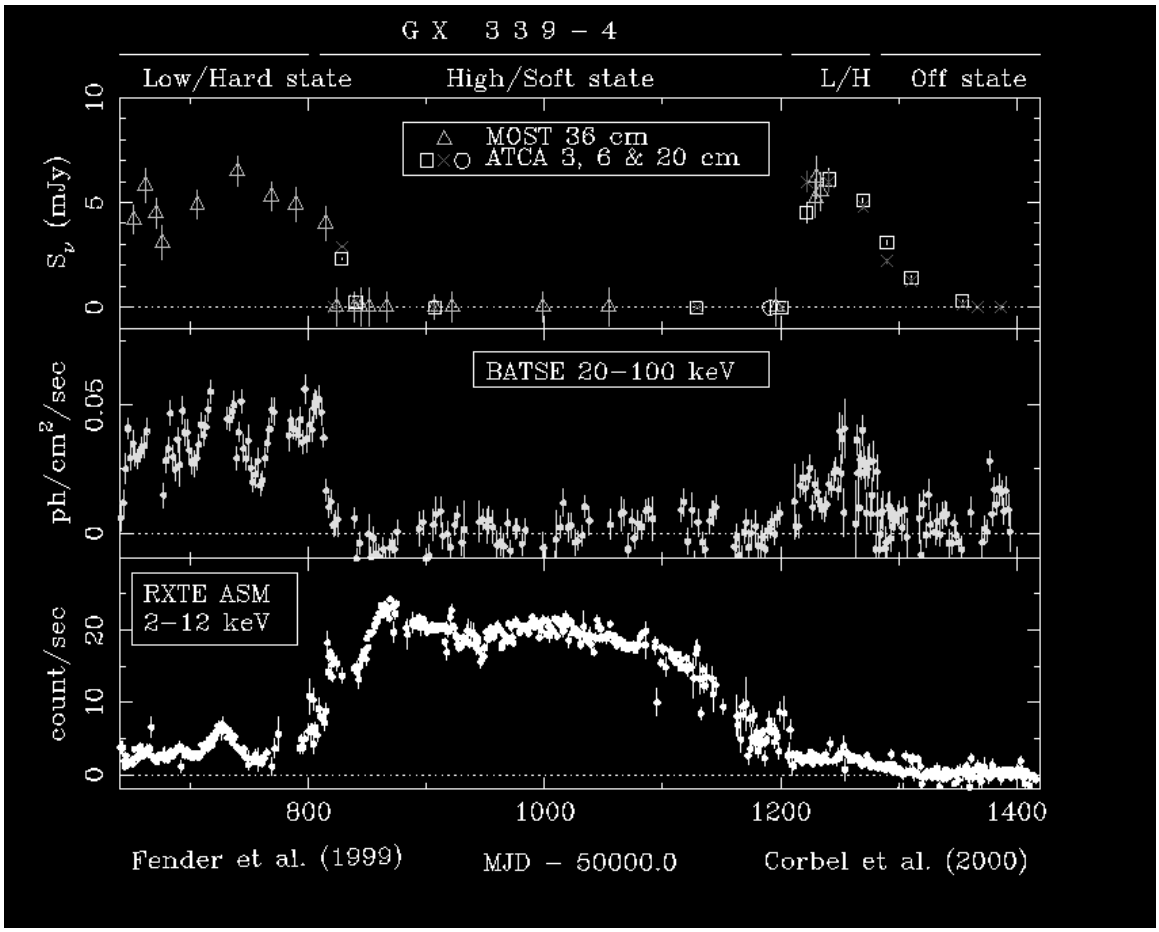

Figure 1: ATCA and MOST radio lightcurves and BATSE and RXTE ASM X-ray lightwaves for GX 339-4.

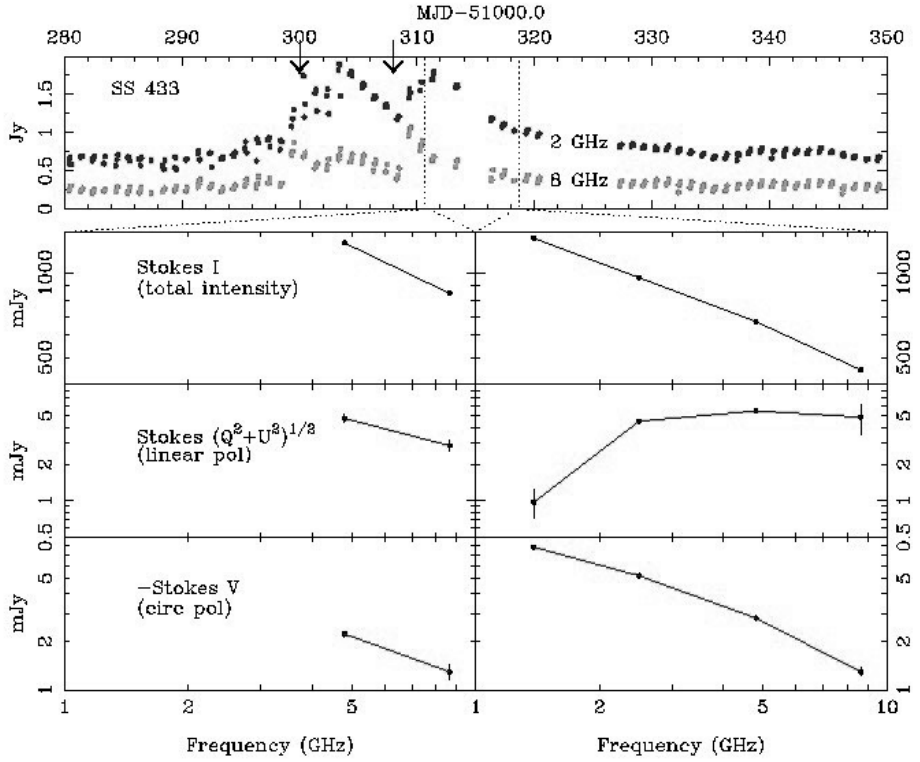

Figure 2: Four-frequency spectrum of SS433 in total intensity, linear polarisation, and circular polarisation, obtained at the ATCA.

that in the high/soft state such a jet is suppressed. Meier (2001) has taken this as the single strongest evidence for the MHD production of jets around black holes.

Polarisation measurements

As well as total intensity monitoring, the extremely good polarisation sensitivity of the ATCA has facilitated discoveries that may well provide clues to the physical nature of the jet, and maybe even its composition. In 2000, using the ATCA, we measured a four-frequency Stokes V (circular polarisation) spectrum from the radio-jet X-ray binary SS 433, the first time such a measurement had been made for any X-ray binary system (Figure 2, Fender et al. 2000).

As with AGN, such measurements of circular polarisation have the potential to probe the magnetic field structure in the jet, and to investigate whether or not the jet is comprised of electrons and positrons or normal (electrons and protons) baryonic matter, a fundamental question in accretion and jet physics. Subsequent observations around the 164-day jet precession cycle, including one observation taken almost simultaneously (all within 48 hours) with WSRT and MERLIN in the Northern Hemisphere are providing high-accuracy polarisation measurements to be compared against high spatial resolution maps (and also to help check the Stokes V calibration of the ATCA and WSRT).

We are continuing to make high-sensitivity observations of a number of X-ray binary sources, in particular those whose radio counterparts reach >100 mJy, opening up the possibility of measuring transient polarisation characteristics. For example, in recent high-sensitivity observations of a transient outburst from the jet source GRS 1915+105, we have measured linear polarisation of "core" oscillation events to the 1 to 2 per cent level with high significance, thereby confirming that the low levels of polarisation observed from these radio cores arise, as expected from a superposition of optically thick and thin components (Fender, Rayner, Trushkin et al., MNRAS in prep).

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Regular items

Square Kilometre Array program report

The SKA program continues to increase in scope, with a number of interesting projects well underway. As well as the technical projects, a considerable effort has gone into framing the SKA demonstrator and enabling technologies section of the MNRF funding application. A very positive side benefit of the MNRF activity has been the formation of SKA groups at the University of Sydney and Swinburne University. While proposals for Australian SKA demonstrators have yet to be developed in detail, it is already clear that we have an excellent opportunity to produce "smart" systems, well integrated with powerful astronomical instruments, and capable of a substantial contribution to the international SKA project.

One of the highlights of the existing SKA program has been the completion of the field work for our initial site testing project in Western Australia. Bruce Thomas spent a month or so working with the Western Australian testing contractors and, in collaboration with Aaron Chippendale, he is currently producing a summary of the outcomes. In the interference mitigation area, new ATNF results using post-correlation mitigation techniques were well received at the recent Bonn conference sponsored by a number of agencies. In allied work, Daniel Mitchell has been working on satellite signal decorrelation in interferometers; he will shortly spend some months with our colleagues at the Allen Telescope Array to extend this work. Recent SKA presentations to a Federal parliamentary science briefing session and the Institution of Engineers National Congress continued our professional outreach program.

In the antennas area, the collaborative project to produce new, low-cost, low-loss, artificial dielectrics for Luneburg lenses is yielding some interesting results. Sample materials using a couple of manufacturing methods have been tested and, significantly, our understanding of the electrical properties of these composite materials has been verified experimentally. As well as four CSIRO Divisions, two industry partners will shortly be involved with the electromagnetics and materials aspects of lens design.

While we plan to construct a 4-m diameter lens using the new technologies being developed, we will shortly be taking delivery of a commercial 0.9-m lens purchased from Konkur, a Russian company. Peter Hall travelled to Russia to organize this collaboration, and with the help of our colleagues at the Pushchino Radio Astronomy Observatory, we expect to have the lens in Australia by the end of June. It will be invaluable in verifying our electromagnetics design and analysis software, and will probably find a longer-term role in our interference mitigation project.

The 0.9 m diameter Luneburg lens shown in Moscow with Russian collaborators Sergei Kutuzov (left) and Rustam Dagkesamanskii.

Peter Hall
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Australia Telescope Compact Array report

Staff

Early in February the Officer-in-Charge Dave McConnell commenced a period of being based at ATNF headquarters in Epping, and now returns to Narrabri for a week every month. The Deputy OIC, Ron Beresford, has been acting for him in the day-to-day management of the Observatory during his absence. Dave retains responsibility and involvement in the scheduling of time on the Compact Array, so all questions regarding telescope usage should still be directed to him. In any case, the OIC and deputy are in daily contact and either can assist with any kind of enquiry from users.

In September 2000 mechanical engineer Clive Murphy was appointed to the observatory staff as the Head of the Engineering Services Group. Clive comes with a wide range of experience in various industrial environments in Australia and overseas, most recently with the large Cargill seed oil plant in Narrabri.

As part of the collaboration between the ATNF and the Academia Sinica Institute of Astronomy and Astrophysics (ASIAA), Taiwanese student Cheng-Jiun Ma from Taiwan is visiting the observatory for three months to gain experience in practical radio astronomy. He has been working under the experienced eyes of Ravi Subrahmanyan and Bob Sault. Cheng-Jiun investigated anomalous refraction effects at 3 mm, evaluated the antenna tracking stability using an optical telescope mounted on an ATCA antenna, and worked on data acquired in a short baseline interferometer with the aim of evaluating methods for rejecting cross-talk. He also gained experience making synthesis images of radio galaxies using ATCA data and the Miriad data reduction package.

Over the summer months the observatory hosted vacation scholars Elizabeth Claridge from the University of Tasmania and Tim Connors from the University of Sydney. Elizabeth worked with Steven Tingay on bent jets in extragalactic radio sources. Tim studied the radio emission from the globular cluster 47 Tucanae with Dave McConnell.

Visit by the new CEO of CSIRO

On 11 April the new Chief Executive Officer of CSIRO Dr Geoff Garrett made a brief visit to the Observatory. In a day which started with a visit to CSIRO's cotton research station at Myall Vale (Division of Plant Industry), Dr Garrett spent several hours addressing staff and inspecting the Compact Array.

MNRF Compact Array upgrade

The first term of 2001 has been quiet in terms of MNRF installation work, after the major receiver installation period in November and December 2000. The main progress has been towards completion of services to the new antenna station posts, both electrical power and fibre optic cables. Another major shutdown has been scheduled for two weeks beginning on 18 June 2001. During that period upgraded versions of the two 12/3-mm receivers will be reinstalled in antennas 3 and 4, and a third receiver will be mounted in antenna 2. Other important work on the new local oscillator (LO) system and the new Antenna Control Computer software is also scheduled for that period.

Ravi Subrahmanyan has been formally appointed coordinator of mm-receiver/LO system tests and commissioning and has been working closely with Bob Sault, Michael Kesteven, David Rayner and others. Commissioning and testing of the new receiver systems on antennas 3 and 4 has continued since December with significant progress in understanding a number of areas:

1) Local Oscillator and interferometer phase stability - A major improvement (factor of two) in the interferometer efficiency was achieved after recognition of a feature of the LO phase monitoring system which was causing a frequent and large variation in LO phase. Once the new LO system is installed this feature will not degrade the performance;

2) Atmosphere and its influence on performance - Large fluctuations in both single dish power and in interferometer amplitude have been identified with "anomalous refraction", the effective wandering of the antenna primary beam caused by phase gradients across the 22-m aperture. The characteristics of this effect and its variation with conditions, time of day, etc, are being investigated;

3) Pointing - An imbalance in the encoder electronics has been identified as the source of a periodic pointing error with amplitude of about 5 arcseconds. As a trial, the offending circuitry in one antenna has been aligned and the pointing error has improved markedly;

4) Optics - The antenna optics alignment and its variations with antenna elevation are being evaluated in order to improve the antenna gain and flatten the gain elevation dependence.

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Parkes Observatory report

Staff

May saw fond farewells to two long-serving members of our technical staff, John Glowacki and Harry Fagg. John has resigned to take up a position with the Bureau of Meteorology in Darwin, though his wife Margaret will continue working in the Visitors Centre until later this year. Harry Fagg has left to lead a mm-wave receiver group at the University of Arizona in Tucson. Both take with them considerable experience which will be difficult to replace.

Operational developments

In addition to the three conventional GPS receivers currently installed on-site, a new "common-view" receiver is now in the process of commissioning, with assistance from Peter Fisk of CSIRO's Division of Telecommunications and Industrial Physics (TIP). This receiver will allow precise comparison of Observatory time with TIP's clocks at Lindfield, which form part of the International Atomic Time (TAI) defining network. This provides access to a second long-term time reference - an important development given recent dramatic improvements in pulsar timing precision.

A paper describing the results of regular timing of pulsar J0437-4715 has recently been accepted by Nature. The team is led by Willem van Straten of Swinburne University of Technology and includes Parkes staff member John Sarkissian, who has been instrumental in making the observations run smoothly.

A great recent success has been the resolution of a long-standing problem with the telescope drives. Regular users will be all too well aware of the irritating random trip-outs in the Azimuth drive that have been occurring every few days. This problem has been around in one form or another since the existing SWEO drives were installed more than a decade ago. After some painstaking detective work, Andrew Hunt has finally diagnosed the problem to a design flaw on the one of the SWEO boards, making it susceptible to transients. A simple modification has been made to all four drives (Az and El), and no further overcurrent trips have been seen.

Several recent developments have been made in improving wind monitoring and antenna safety. The anemometer formerly in the paddock to the west of the Avenue has been relocated to the old Telstra tower east of the telescope, away from encroaching trees. A second anemometer has been mounted on the high edge of the dish, to give measurements as close as possible to the structure. In addition, enhancements have been made to the SERVO code to handle high wind in a more logical and straightforward way, and old code to stow on low or high Zenith currents has been reactivated (after ten years!). Some inconvenience to observers with excessive wind-stowing was occasioned in February and March while these changes were implemented and new thresholds refined, but the system is now working well, with much improved long-term safety for the antenna structure.

The battle against radio frequency interference (RFI) continues. Mal Smith has commissioned a sensitive new instrument for detecting interference: the Interference Measurement System (IMS), and this should be fully operational shortly. An anechoic chamber in the old "Woolshed" is under construction and will allow easier and more thorough testing of new equipment for RFI properties. Steps are underway to establish contact with the US Air Force to identify in advance periods of intense GPS L3 usage. This system, centred at 1381 MHz, causes severe interference in this band both at Narrabri and Parkes. A new mysterious source of interference in this band from the northwest quarter, resembling solar interference, has recently appeared and is consuming considerable efforts in its characterisation and identification.

Site Services

Completion of the Visitor Centre grounds landscaping, the refurbishment and installation of the Whisper Dishes, placement of the Earth Ball, Sun Dial and other displays, modifications to the lecture theatre for the new 3D show, construction of new display boards and shelving and construction of the opening ceremony "boom gate" saw Site Services working extremely hard to successfully complete preparations prior to the official opening of the Visitors Centre extensions by Dr Geoff Garrett on 24 March.

This was followed in early May with a short shutdown during which ultrasonic and magnetic particle testing of the tripod lynch pins and Zenith

drive racks and pinions was undertaken. The Zenith No. 2 motor was overhauled, modifications to the control room undertaken and an extensive list of engineering inspections carried out.

Concurrent with preparation and execution of the shutdown, Site Services was also fencing, slashing, installing lighting, sound, movie screens and repairing roadways to prepare the site for The St. Vincent de Paul Society's "Night under the Stars". This event saw around 800 people attend, with about 600 of them camping out on a section of the grazing lease, to launch the 2001 winter appeal to assist the homeless.

Work is now under way to construct an anechoic chamber for RFI measurements, fabricate parts for the new Chinese receiver to be assembled latter in the year, complete the grazing lease re-fencing and improve access to the site engineering drawings.

John Reynolds (Officer-in-Charge) and Barry Turner
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Australia Telescope Compact Array Report

Initial measurements have been made of the antenna 3 subreflector translation and rotation under elevation changes. Difficulties have been encountered in isolating subreflector and quadrapod movement. Work will continue, with the aim of characterising the quite small movements that may impact on the performance of the antenna at 3 mm.

ATOMS/ACC

This project now has a good workforce with Scott Cunningham and David Brodrick working under Mark Wieringa's leadership, and Dave McConnell working remotely from Sydney. The group now reports the assembly of the first of the new Antenna Control Computers in its final form and its successful testing with a major subset of the new software.

Other observatory work

A network connection is being installed to the Lodge. This will provide more facilities for monitoring the telescope operation while relaxing over a meal. It will also serve electronic displays needed for the coming ATNF Synthesis Workshop to be held at the Observatory in September.

Visitors will admire the new staircase in the control building. This has been lengthened and tiled and provides a more gentle climb up to the observation areas. A number of improvements have been made to the grounds, including a very smart new fence around the new car park in the Visitors Centre. Being planned at present is an avenue of native shrubs along the path to the Lodge.

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

Ron Beresford, Deputy OIC Narrabri, with CSIRO Chief Executive Officer Dr Geoff Garrett and Dr Jim Peacock, Head of CSIRO Plant Industry, while at Narrabri during the recent visit.

Time Assignment Information

The allocation of time on the ATNF facilities is done on the basis of scientific merit. For the year 2000 a total of 168 proposals were allocated time (each proposal is counted once only per calendar year although some proposals are submitted two or three times each year). Of these, 112 were for the Australia Telescope Compact Array, 36 were for the Parkes telescope, 10 were for the Mopra telescope and 10 were for the Long Baseline Array. Figure 1 shows the time allocated on the Australia Telescope Compact Array (counted by the affiliation of the principle investigators) as a percentage of the total allocated time. For the years 1993-1999 approximately 40% of time was allocated to proposals with principle investigators at overseas institutions. In the year 2000 however, the percentage of time allocated to overseas proposals increased to over 50%.

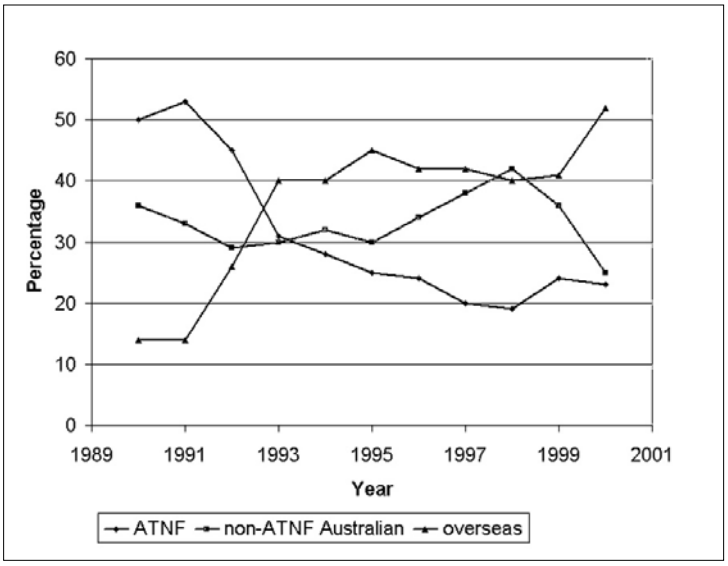

Figure 1: Compact Array time allocation for the years 1990 to 2000

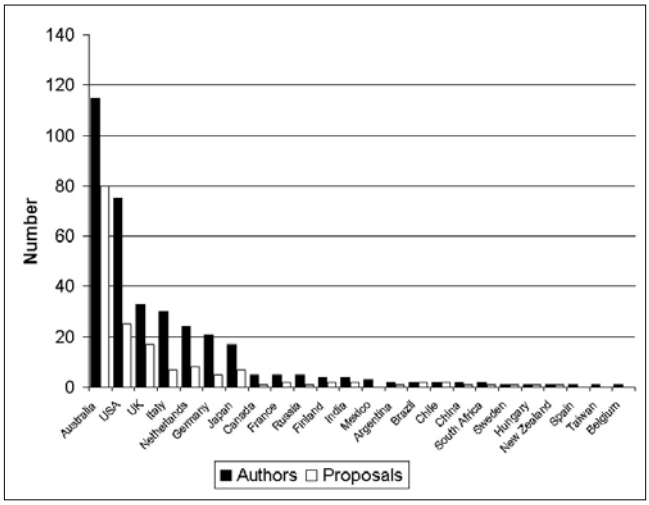

Figure 2: Overseas and Australian participation in 2000

For the year 2000 the proposals allocated time on ATNF facilities included a total of 358 different authors. Of these 38 authors were from the ATNF, 77 were from 16 other Australian institutions and 243 were from 98 overseas institutions in 23 countries. Figure 2 shows the number of proposals (counted using the principle investigators) and the total number of authors from each country.

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ATNF publications list

Publication lists for papers which include ATNF data are available on the web at http://www.atnf.csiro.au/research/publications. Please email any corrections or additions to Christine van der Leeuw (cvdleeuw@atnf.csiro.au).

This list includes published refereed articles and conference papers, including ATNF data, compiled since the February 2001 newsletter. Papers including one or more ATNF authors are indicated by an asterisk.

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