ATNF News

e-VLBI progress on the Long Baseline Array

Chris Phillips, Tasso Tzioumis & Shaun Amy (ATNF)

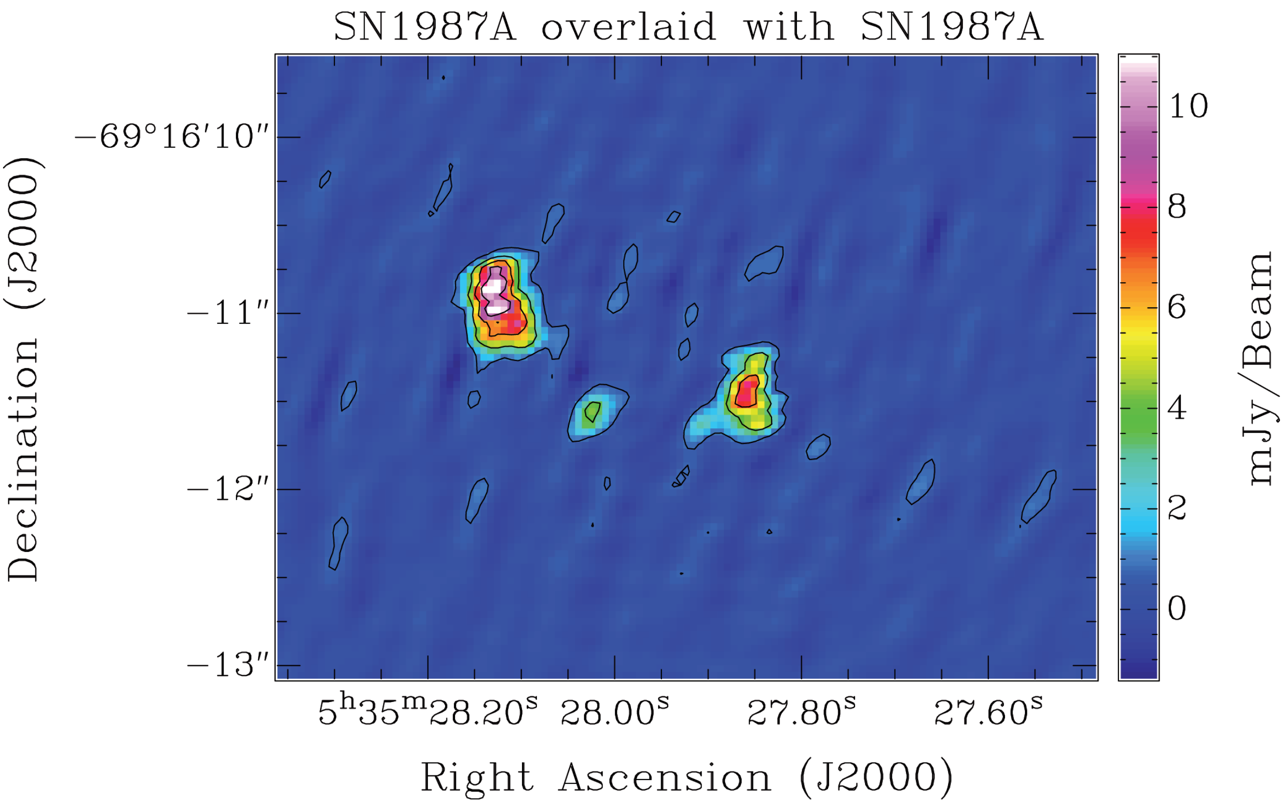

Figure 1: e-VLBI image of SN1987a at 1.4 GHz. The peak brightness is 13 mJy/beam and the noise level is 350 µJy/beam. The three clumps represent hotspots within the shell surrounding the supernova remnant – the bulk of the shell is resolved out at VLBI resolutions.

The last year has seen rapid progress of e-VLBI (Electronic Very Long Baseline Interferometry) technology on the Long Baseline Array (LBA) with many successes and "firsts".

In collaboration with the Joint Institute for VLBI in Europe (JIVE) and Australia's Academic and Research Network (AARNet), ATNF is a member of the Express Production Real-time e-VLBI Service (EXPReS) project. This is a European Union funded project to develop production e-VLBI for the European VLBI Network (EVN). One part of the project has been to demonstrate real-time e-VLBI from Parkes, Mopra and the Compact Array with data being sent over international network links to the EVN VLBI data processor located at JIVE in the Netherlands. To achieve this, AARNet worked with international partners to secure three dedicated one-Gbps "light paths" from the three observatories to JIVE. While the connection crosses numerous separate network providers, a light path is presented as a single continuous connection to the end user with no network congestion due to other users.

As a precursor to the EXPReS demonstration, in August 2007, the Mopra radio telescope took part in an international e-VLBI demonstration held as part of Asian Pacific Advanced Network (APAN) meeting in Xi'an, China. Data from Mopra were sent over a single light path to JIVE at a rate of 256 Mbps (with

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Editorial

In this issue we focus on some of the new developments currently underway or being planned at the ATNF. In our front-page report, Chris Phillips describes some of the recent achievements for electronic VLBI in Australia. On page 7 Jessica Chapman discusses the plans and community consultations for ATNF Future Operations. David McConnell provides an update on the new Compact Array Broadband Backend (CABB, page 10). CABB is a major upgrade for the Compact Array that will provide astronomers with a much wider bandwidth, allowing more sensitive observations as well as excellent options for spectral-line observations.

This issue sees a change of hands for the *ATNF News*. Our editor, Michael Dahlem has recently left the ATNF. We thank Michael for his tremendous contribution to the newsletter over the last two years. We welcome Mary Mulcahy who started a position at the ATNF as Communications Manager in December 2007. Mary has joined the newsletter team for this issue and will take over from Jessica Chapman from the next issue onwards. From this issue onwards the *ATNF News* will be issued twice a year in April and October.

Jessica leaves the newsletter in great hands and would like to thank everyone who has contributed to this since she first joined the newsletter team for the October 2000 issue.

If you would like to contribute to later editions of the ATNF news, please contact the newsletter team.

As this issue went to press, the ATNF was saddened to hear of the death, on 10 May 2008, of Dr John Paul Wild, the former Chief of CSIRO Radiophysics, and later Chair of the CSIRO Board. We will include a profile of his career and outstanding contributions to radio astronomy in the next issue of ATNF News.

Jessica Chapman, Mary Mulcahy and
Joanne Houldsworth
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From the Director

Brian Boyle (CSIRO ATNF Director)

Over the past few months, I have been delighted to hear the strong words of support expressed for Australia's participation in the SKA program by senior Australian and West Australian State Government Ministers and officials. In particular, the opening supporting and visionary remarks made by Senator Carr, the Minister for Innovation, Industry Science and Research and Premier Carpenter were generally identified by the 200+ delegates present to be one of the highlights of the highly successful SKA Forum 2008 event held in Perth in April. With this support comes responsibility. CSIRO – and indeed the Australian community more broadly – now has a very strong requirement to deliver the Australian SKA Pathfinder (ASKAP) project, the Murchison Radio-astronomy Observatory (MRO), and astronomy community participation in the international SKA project, principally through the EU FP7 Preparatory study for the SKA project.

In delivering on our SKA commitments, we also need to deliver on the operation of existing infrastructure. The real cost of operations is increasing, with salary costs growing by approximately four to five per cent per annum, while funding to the Operations Theme remains fixed in dollar terms. Given this situation, change is essential. As flagged in the Decadal Plan for Australian Astronomy for 2006 – 2015 the Australian astronomy community is faced with opportunities and some difficult choices. The ATNF is committed to prioritizing its activities, making necessary choices not to do some things, and being driven in making those choices by the need to maximize scientific impact rather than simply scientific output. The growth in funding associated with the commitment by CSIRO and the Australian and Western Australian Governments to ASKAP will greatly increase the science possible with ATNF facilities, but creates increased competition for limited resources. Without ASKAP and the international SKA program, the future of Australia's existing radio astronomy infrastructure would have been much less certain.

The competition for limited staff and other resources is the primary reason that the ATNF is unlikely to take on any new projects in coming months beyond those already committed to. Following the completion of Compact Array Broadband Backend (CABB) in 2009, the future development activities of the ATNF will focus on two key activities, ASKAP and the facilitation of a new operational model including improving the automation of our facilities and the establishment of a Science Operations Centre. Even now, balancing resource requirements between CABB and ASKAP is challenging, as both face emergent work in technical (receiver interface modules) and Governance (Public Works Committee) areas respectively.

While this environment results in the need to change and to deliver on sometimes daunting timescales, it also creates great opportunities and a sense of excitement. In recent months the ATNF has recruited around twenty new staff across all areas of activity, and another six or so positions will be filled soon. In late April the ARC announced that the proposal for Chris Carilli to hold a Federation Fellowship at CSIRO was successful.

The vibrancy associated with new staff and new challenges is palpable, and with it comes a need to maintain and enhance communication at all levels. This includes communication within the ATNF, with our CSIRO colleagues as part of the CSIRO-wide approach to ASKAP, and with our external users and stakeholders.

The operations road show was one specific activity undertaken over recent months to address the need for effective two-way communication between the ATNF Leadership Team, the broader ATNF staff, and the user community. This will continue as we develop further the ATNF Operations plan. Preparation of three key science planning documents will proceed in parallel with the development of the Operations plan. Working titles are:

1. Focussed Science with Parkes in 2010-2015 (drawing on the Science with Parkes workshop on 5 November 2007);

2. Looking Out: The role of the ATCA in the ASKAP/ALMA Era (drawing on the ATCA Science workshop planned for 11 June 2008 and the 2007 millimeter white paper);

3. ASKAP Operations and Functional Requirements (drawing on the ASKAP Science case).

Drafts of all will be prepared by the end of June and ATNF will undertake a Science Planning roadshow in July.

Finally, I would like to congratulate ATNF staff and users for the many achievements outlined in the following pages. The number of proposals for observations with the ATNF's telescopes in this April semester was unprecedented, exceeding the previous record by about 30%. The ATNF telescopes continue to produce a wide variety of outstanding science results due to the winning combination of ATNF staff, equipment and the users of the facility. The success of the e-VLBI team as the inaugural winners of the US IDEA (Internet Driving Exemplary Applications) award, further underscores astronomy's ability to drive the innovate use of technology and augers well on our promises to deliver in this area.

ASKAP update

Dianna Londish (ATNF)

ASKAP antenna tender

A Request For Tender (RFT) was released in mid-March 2008, with a deadline of 19 May 2008. Interested parties were invited to an information session at Marsfield on 27 March where the antenna specifications were presented. These are:

- Prime focus (single reflector) on an azimuth-elevation mount with a third (polarisation) axis;
- 12m unshaped paraboloid with a focal length: Diameter (f/D) ratio of 0.5;
- A quadrupod feed leg support and prime focus platform able to support a load of 200 kg; and a
- Reflector surface capable of operation to 10 GHz (or better).

The required 30 square degree field-of-view will be achieved using a focal plane array, creating 30 separate simultaneous beams.

Design study for a data transmission link

A new optical-fibre network connection from the Murchison Radio-astronomy Observatory (MRO) in the mid-west of Western Australia to a site in Geraldton is required. As the MRO is Australia's candidate site for the SKA, it is planned to have sufficient fibre installed to meet the estimated needs of the SKA.

CSIRO has contracted AARNet (Australia's Academic and Research Network) to conduct a design study to define technical options for the project, make cost-benefit analyses for different options, design the fibre route, produce a detailed costing of the entire project, and analyse project risks. The study will be carried out during March – June 2008.

After the completion of the study, proposals will be requested for the implementation phase of the data transmission link. The Request for Proposals will be posted on AusTender and the procurement process will strictly follow the Commonwealth Procurement Guidelines.

Parkes testbed facility

Earlier this year the ASKAP project began the process of commissioning a single 12-m diameter antenna built by Patriot Antenna Systems. This antenna has now been assembled on site at Parkes Observatory and testing is continuing. It will provide a dedicated platform for field tests of the phased array feeds for ASKAP. The Parkes radio frequency interference environment is significantly better than Marsfield, and the 64-m telescope in tandem with the new 12-m antenna, will be used for deeper, more sensitive testing of the phased array feeds.

Although the functional specification and design of the 12-m antenna at Parkes differs from that for the actual ASKAP antennas, it will provide a single dedicated system to test successive generations of phased array feeds in readiness for ASKAP itself. In particular the antenna will be equipped with a feed rotator at the prime focus to allow the phased array feed to maintain a constant parallactic angle during observations. This “de-rotation” of the sky means that the data stream from the phased array feed will be significantly easier to process in the imaging software.

Site preparations, including foundations and services for the Parkes 12-m antenna, have been completed by CSIRO ATNF Parkes staff in consultation with Patriot. The new antenna is located approximately 400 metres east of the 64-m Parkes radio telescope, parallel to the east-west interferometer track, on a level area of land previously leased for farming.

The antenna reflector comprises “stretch-formed” solid panels, and is very similar to the Patriot antenna built for NASA-JPL. The pedestal will house an ASKAP-style beamformer. One of the challenges for ASKAP is to determine a ventilation system for the pedestal due to its high heat output (estimated to be about 5 KW). An underground fan-duct system has been installed to provide naturally-cooled forced air to the pedestal. Over the first months of operation the efficiency of this system will be assessed to determine if it will be suitable in WA.

The Parkes 12-m test-bed will be controlled from a newly-refurbished RFI-shielded room in the Parkes “Woolshed”.

ASKAP array optimization

The Science Group at ATNF has been working on optimising an ASKAP configuration for surveys that will require 20 – 30 arcsec resolution as well as looking at configurations that will give a resolution of about five arcsec. To begin with, optimisations

Photo: Barry Parsons

Steve Broadhurst & Norm Webster tightening the final bolts on the reflector structure 17 January 2008

Photo: Barry Parsons

Reflector assembly on 18 January 2008 – awaiting installation of panels

were performed for arrays of 45 antennas spread over 8 km, observing sources at –90, –60, –30 and 0 degrees in declination.

A visit by Jim Condon (VLA, NRAO) proved useful in connection with optimising the resolution for the ASKAP continuum survey, including considerations of the confusion limits and surface brightness sensitivity. The main outcome of these discussions was that, for completeness, we should be aiming at something more like 10 arcsec than 5 arcsec. This has implications for the configurations we are adopting. Jim Condon’s memo on this can be found at *www.atnf.csiro.au/projects/ska/Memoseries.html*

More recently the possibilities for hybrid configurations have been explored, motivated by the science case, and currently the performance of these arrays is being compared with those of a scale-free configuration.

A detailed site mask has been prepared based on environmental and heritage surveys conducted at the Murchison Radio-astronomy Observatory.

ASKAP power requirements

Green energy solutions for ASKAP power energy requirements are being looked into. A variety of solar power units will be investigated, as well as wind. One key aspect is to design the array for efficient power consumption, incorporating passive designs where possible.

SKA fortnight in Perth

A conference on science with SKA Pathfinders was held during the week of 31 March – 4 April 2008. It was a very well-organized, well-attended conference (about 170 participants, 100 from overseas) at the University Club at UWA in Perth. There were many superb talks by people eager to start using ASKAP. The presentations are all on-line at *http://ska2008.ivec.org/SKA_Pathfinder-talks-posters.htm,* please contact one of the conference participants if you would like one of the papers.

A select group of delegates was able to get to the MRO on the weekend (5 – 6 April) for a tour: Yervant Terzian, Richard Schilizzi, Peter Dewdney, Ken Kellermann, Jim Cordes, Andy Faulkner, Mike Jones, Bernie Fanaroff, Justin Jonas, Anita Loots, Don Backer along with ASKAPers Dave DeBoer, Carole Jackson and Phil Crosby. Everyone met in Geraldton for breakfast with the local civic leaders. Thanks go to Priscilla Clayton (newly appointed ASKAP Regional Manager) for arranging this as well as a wonderful lunch and many other details! The wet weather necessitated some change of plans, but the crew gamely drove into the bush and covered 950 km in total, of which over 700 km was on wet dirt roads.

In the second week there were many meetings, mostly industry, SKADS and PrepSKA related. See auSKA Newsletter 19 for more reviews. The highlight was the SKA Forum on 9 April. Garth Illingworth's keynote talk was excellent. Minister Carr and Premier Carpenter both gave very supportive talks. The attendees commented on and were impressed by the level of support within the Australian government.

Photo: CSIRO

View over the Murchison Radio-astronomy Observatory (MRO) site.

ATNF future operations

Jessica Chapman (ATNF)

Photo: Shaun Amy, ATNF

The ATNF Operations Group at Narrabri during a get-together on 30 April 2008.

Background

A major challenge for the Australia Telescope National Facility (ATNF) today is to plan our future operations. By 2012 the Australia Telescope National Facility will be operating four observatories; our current facilities – the Australia Telescope Compact Array, the Parkes and Mopra radio telescopes – and the Australian SKA Pathfinder telescope (ASKAP), now under construction.

The ASKAP project is an international collaboration to build an array of dishes as a "pathfinder" instrument for the SKA. As well as carrying out sensitive astronomical observations for key science projects, ASKAP will demonstrate new technologies relevant to the SKA. The array will be located in the Mid-West region of Western Australia within a radio-quiet region designated as the Murchison Radio-astronomy Observatory, and will have up to 36 12-metre diameter antennas.

At the ATNF we are now planning the changes to our Operations that will enable us to operate ASKAP whilst also continuing to be a leader in radio astronomy and to carry out world-class research with our current facilities. These requirements, together with a limited budget for recurring operations, have led to an extensive period of planning for our future ATNF Operations.

Planning for the future

In mid-2007, after an extensive internal review of our Operations Theme, the ATNF Leadership Team (ALT) set up two working groups to discuss possibilities for a future operations model. The Science Operations Working Group (Chair: Jessica Chapman) and the Engineering Operations Working Group (Chair: Brett Dawson) were set up to represent a broad range of experience and perspectives within the ATNF. Group members consulted with a wide range of individuals and organisations and compiled a review of operations at other facilities.

In September 2007, the two working groups provided internal reports to the ATNF Leadership team (ALT). Based on these reports, and further ALT involvement, the ALT prepared a report, *Future ATNF Operations,* for discussion with the ATNF Steering Committee in December 2007. This document was made available through the ATNF website in February 2008.

This document and other information is available on the ATNF website. Please see *www.atnf.csiro.au/observers/planning/* and the links from there.

In summary, the ATNF has now committed to making the following changes:

1. Restructure Operations staff into two "streams" for Science Operations and Engineering Operations;

2. Establish a Science Operations Centre (SOC) at Marsfield;

3. Streamline supported observing modes and the telescope scheduling software.

These changes can be thought of as providing the framework for our future operations. Whilst the internal restructuring of ATNF Operations is now well underway, the detailed planning for the construction and operations of the Science Operations Centre, and for streamlining telescope scheduling and supported observing modes, are far from finalised. The planning for these will occupy much of this year and will take into account extensive consultation with our user community.

In this newsletter article I discuss below the ATNF consultation with the user community on the operations plans, and the internal restructuring of ATNF Operations. Further information will be provided in later issues of *ATNF News* and through the ATNF website.

Community consultation

Following the initial release of the document *Future ATNF Operations*, it was clear that many ATNF users had significant concerns with the proposed plans and with the document itself. In response to this, we considered how to best consult with the user community and seek their input. Several different approaches were used.

During March and early April 2008, Jessica Chapman, David McConnell and Lewis Ball visited groups of astronomers from eight universities in Sydney, Canberra, Hobart, Perth and Melbourne to present the plans and gather feedback through discussion. These visits were extremely valuable in helping us to understand a diverse range of perspectives and interests from different regions within Australia, and the different concerns of particular research groups. Further discussion was held during a well-attended forum in Marsfield in mid-March, while the ATNF Users Committee has also encouraged and received feedback.

It is harder to communicate directly with our overseas users, and with this in mind, a web forum was set up to facilitate input from both Australian and international astronomers. This proved to be an effective technique, with detailed and perceptive written comments received from approximately 35 individuals, again representing different parts of the international community.

We thank everyone who has contributed to the discussion so far. We are now considering the feedback received and would like to advise the following timetable.

Mid-May 2008: The web forum for discussion of the Version 1 of the *ATNF Future Operations* document will be closed so that we can compile a summary of the input received and prepare a response.

End-May 2008: A joint ATNF and ATUC summary of the feedback, will be made available on the ATNF website. This will be prepared by Jessica Chapman and Elaine Sadler (ATUC Chair).

June 1- 5 2008: David McConnell & Jessica Chapman will attend the meeting of the American Astronomical Society (AAS), to be held in St Louis, US, to present and discuss plans for ATNF facilities and future operations.

Mid-June 2008: ATNF will provide a response to the issues raised in the web forum and through the consultation process. This will be made available on the ATNF website.

June – July 2008: The ATNF will be considering the science goals and priorities for ATNF facilities for the years 2010 – 2015. The intention is to better identify our science strengths and priorities within the global context, as we move into the ASKAP era. We will again consult with the user community in several ways. On 11 June 2008 a Compact Array Science Day will be held at the ATNF in Marsfield. This will be similar to the Parkes Science day held in

November 2007. The science goals will be discussed at the meeting of the Astronomical Society of Australia (6 – 10 July). Also in July, ATNF staff will visit Australian Universities for presentations and discussions.

End-July 2008: Version 2 of the document *Future ATNF Operations* will be released following consideration of the user input and the science cases. This version will be written for a broader audience and will provide more context and discussion of the plans than the original version. Note that this will not be a "final statement" of the development plans but will provide up to date information on the development projects and their budgets and timescales.

A new structure for ATNF Operations

The ATNF Operations group is now being restructured from a "site-based" management structure to a "functions-based" structure. The new structure formally replaces the current structure on 1 July 2008.

In the new structure David McConnell continues as the Operations Theme Leader. In January 2008, Jessica Chapman took on a leadership role as the Operations Research Program Leader, with overall responsibility for Operations staff and capabilities. Within the Operations theme two "Streams" have been set up for Engineering Operations and Science Operations, and in January 2008 Brett Dawson and Phil Edwards were appointed as the Head of Engineering Operations and Head of Science Operations respectively. Phil continues as the Narrabri Officer-in-Charge until July 2008.

In the new Operations structure, the work activities for ATNF Operations are structured within eight "operational" projects, with four in engineering operations and four in science operations. These project teams will work together to share knowledge and resources with the overall aim of achieving a better integration of our capabilities and systems across the different ATNF facilities. Each project has a project leader and a project team that includes staff from two or three ATNF sites. The project leaders were announced in March 2008, following an internal process with a call for expressions of interest — congratulations to all those staff taking up these new roles.

In addition, to facilitate the management of local issues, the Parkes and Narrabri sites will also have a Site Manager / Technical Coordinator. The Site Manager will be the key point of contact for site-related queries, while the technical coordinator will coordinate day-to-day "corrective" maintenance activities and transition periods between Engineering and Science Operations. Brett Hiscock will take on the roles of Site Manager and Technical Coordinator at Narrabri. At Parkes Brett Dawson will be the Site Manager, with Brett Preisig taking on the role of Technical Coordinator.

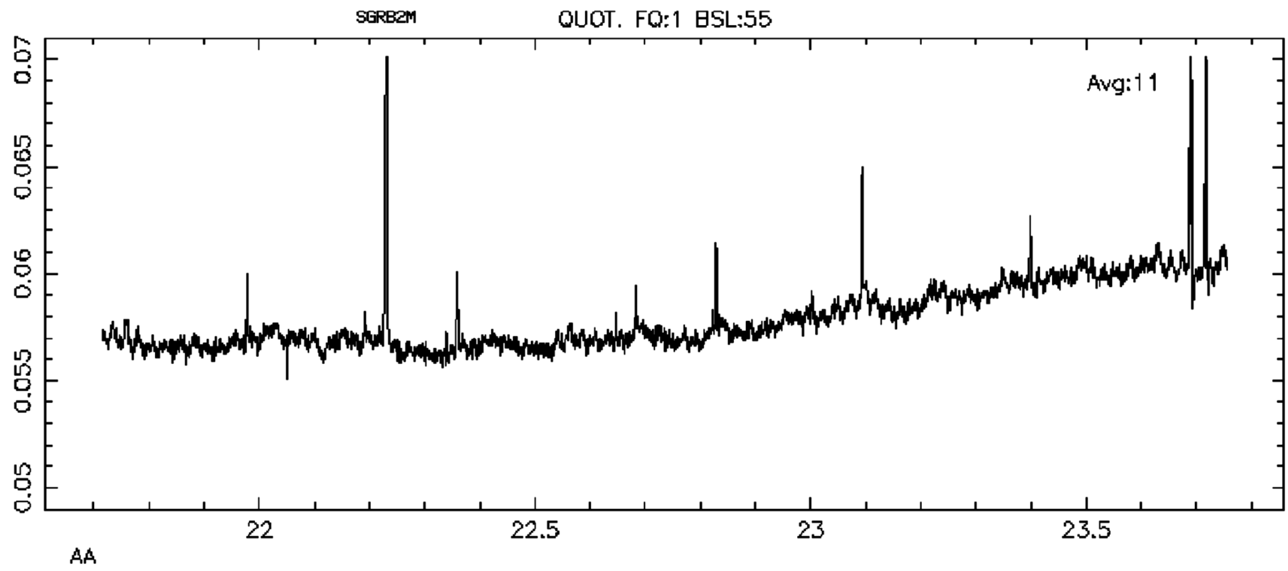
A major change at both Observatories will take place in July 2008 with the end of the Officer-in-Charge positions at the Parkes and Narrabri Observatories. From July 2008 John Reynolds, the current Parkes Officer-in-Charge, will work as a System Scientist for both Parkes and ASKAP, with a likely move to Sydney at end-2008. Phil Edwards, the Officer-in-Charge for Narrabri and Mopra, will be the Head of Science Operations, and expects to remain at Narrabri until end-2009.

In June 2008 we will be advertising internationally for two high-level System Scientists, one for the Parkes Observatory and one for the Narrabri Observatory, with a deadline for applications at the end of July. If you may be interested in these key positions, and for any enquiries on the Operations restructuring, please contact Jessica Chapman for further information.

Over the last few months we have been working to set up this new structure and to define the work roles and line management for all individual staff members. A recent highlight for ATNF Operations was a two-day meeting held in Narrabri on 29 – 30 April 2008. This was attended by almost all Operations staff from Marsfield, Narrabri and Parkes, who gathered in Narrabri to discuss the operations plans, meet each other, tour the Narrabri facilities and begin working within the new project teams. For many people this was the first opportunity to meet some of the staff from other locations, and one of the recurring topics of discussion was how best to communicate across widely separated locations. Overall, it was a very enjoyable and positive two days and a milestone towards our future operations.

Compact Array broadband update

David McConnell (ATNF)



CABB autocorrelation spectrum from antenna CA05 spanning 2GHz, November 2007 (courtesy Warwick Wilson).

Development and production of the new broadband backend system for the Compact Array (CABB) is approaching completion. Two stages of installation are being planned this year. The final system will provide an increase in bandwidth of the Compact Array from the current 128-MHz to 2-GHz, a factor of 16 improvement. This will improve the continuum sensitivity by at least a factor of four as well as providing a greatly enhanced spectral line performance, particularly at the higher observing frequencies. The wider bandwidth will allow projects studying spectral lines within a 2-GHz band to be carried out simultaneously. The first phase of installation has begun and will result in an interim system making available one 2-GHz band on five of the six antennas at millimetre wavelengths. Operation of this interim system will be established in parallel with the original correlator and conversion system, and will be used for some early scientific projects during the current 2008APRS observing semester. The full system will be installed, replacing all the old equipment, late in the 2008OCTS semester. The ATNF telescope availability statement for next semester, which will be available from 15 May, will contain more details on the installation schedule.

The CABB project team expect to get fringes on a single-baseline interferometer by late May, and to have five antennas (ten baselines) in use by July. The CABB correlator modules have been proven (see autocorrelation below) and production of the 32 modules required is well advanced. Digitisers and signal transmission from the antennas to the correlator room have also been proven. In the new system, all delay compensation and fringe rotation is integrated into firmware devices located centrally with the correlator; that firmware is in the final stages of integration. Work continues on an upgrade to the MIRIAD package needed for use with the new data products. The traditional data format, RPFITS, will be retained but the increased data volume and broad fractional bandwidths necessitate some changes to the calibration and imaging software.

ATNF engineering and support staff will work closely with those teams who have access to the early version of CABB over the next few months. The observing modes with the interim version will be limited, but early experiences will be valuable for commissioning the final system.

We look forward to some early scientific results.

e-VLBI progress on the Long Baseline Array

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a sky bandwidth of 64 MHz). Also participating in the demonstration were the Shanghai telescope, and European telescopes in Poland (Torun), UK (Jodrell Bank & Darnhall) and the Netherlands (Westerbork). A highlight of the demonstration was fringes between Mopra and the European telescopes. The Mopra – Darnhall baseline is 12,304 km which is the longest real-time baseline every observed (and close to the longest baseline possible for terrestrial observations).

The actual EXPReS demonstration involved Parkes, Mopra and the Compact Array. Each telescope sent data to JIVE at a rate of 512 Mbps (128 MHz sky bandwidth), sustained for 11 hours. A total of 7.6 TB of raw baseband data was transferred. For the demonstration observations were taken of supernova SN1987A, at a frequency of 1.4 GHz. The resulting image, shown in Figure 1, with a synthesised beam of 85 x 168 milli-arcseconds, is the highest resolution at which the supernova has ever been observed. VLBI resolves most of the structure of the shell surrounding the supernova, other than three hotspots. The VLBI image is consistent with a tilted optically thin ring model (cf Gaensler et al. 2007). Brightness enhancements correspond to the longest pathlength regions along our line of sight. The results have been written up in Tingay et. al. (2008).

The Australian LBA Dish Recorder (LBADR) recording system used for VLBI data is not directly compatible with the Mark5 system used in the EVN. For these demonstrations the recording software was modified to (optionally) do an “on-the-fly” data conversion to the “Mark5b” data format, which can be directly read into the EVN data processor at JIVE. This approach worked very well and demonstrates the flexibility of the LBADR recording system. Disk based observations can also be recorded in Mark5b format, which allows data recorded on the LBA to be easily sent to other international correlators. This has been successfully demonstrated in a high frequency geodesy observation, which was correlated on a geodetic correlator at Bonn, Germany. This experiment has been used to improve the absolute positions of LBA antennas that do not take part in normal geodetic observations (at Mopra, the Compact Array and Ceduna).

Photo: Steven S. Wallace

Shaun Amy (on left) accepting the IDEA Wave of the Future Award at the Internet2 Spring Members’ meeting, from Randy Brogle (Level3 Communications)

e-VLBI developments with a direct impact on LBA observations have also been progressing. The initial "first science" setup sent all network data through a single PC to the CPSR2 computer cluster at Parkes. This gave an upper limit to the data rate of 256 Mbps per telescope. By replacing this single PC with a set of dedicated machines, and with hand-crafted network engineering to use all possible network links into Parkes, we have been able to maintain a sustained rate of 512 Mbps for the three ATNF telescopes. For high sensitivity observations, a data rate of one Gbps between the Compact Array and Parkes has been tested and works very well. The software correlator will shortly be migrated over to the recently-installed ATNF Parkes Swinburne Recorder (APSR), a 20-node cluster of PCs at Parkes. Network connectivity into Parkes means we cannot use the increased processing power of APSR to increase the e-VLBI data rates, at present.

e-VLBI techniques are also routinely being used to allow completely remote operation of Mopra. Rather than recording data directly on hard disk drives at Mopra (which would require a local observer), the data are streamed over the network and recorded on disks at Narrabri, where observers handle the logistics of swapping disks as necessary. This is handled seamlessly by the recording software and has worked extremely successfully.

Continuing with international collaboration, a further e-VLBI demonstration will be held in June 2008. Data from Kashima in Japan and Shanghai in China will be streamed in real time to Parkes where it will be correlated with data from ATNF antennas. At this stage the plan is to receive data from all telescopes at 512 Mbps, giving a total data rate of 2.5 Gbps. For compatibility reasons, the software correlator has been modified to accept e-VLBI data in "Mark5" format.

PIs are encouraged to submit e-VLBI proposals through the normal ATNF application process. Data rates of up to 512 Mbps are achievable for a Parkes-Mopra-ATCA array or 1 Gbps between the ATCA and Parkes (or potentially Parkes and Mopra).

ATNF wins IDEA Wave of the Future Award

The ATNF's e-VLBI achievements have been recognised with the award of the first IDEA (Internet2 Driving Exemplary Applications) Wave of the Future Award. The prize is a private 10 Gbps link across the USA for one year (sponsored by Level3 Communications), and this was accepted by Shaun Amy at the Internet2 Spring Members' Meeting held in Arlington, Virginia on 22 April 2008. Initially the connectivity will be used to work with colleagues at Haystack Observatory run by Massachusetts Institute of Technology and to establish a connection into Europe.

References

Gaensler, B.M. et al. 2007, "Supernova 1987A: Twenty Years After: Supernovae and GammaRay Bursters", ed. S. Immler, K.W. Weiler & R. McCray, American Institute of Physics, New York, 937, 86

Tingay et al. 2008, ApJ Letters, submitted

ATNF distinguished visitors

Robert Braun (ATNF)

Over the past months we have enjoyed working visits from Phil Kronberg (Univ. Toronto/LANL), Marijke Haverkorn (NRAO/UC Berkeley), Jim Condon (NRAO), Ger van Diepen (ASTRON) and Martin Cohen (UC Berkeley). Current visitors include Sanjay Bhatnagar (NRAO). Upcoming visitors we expect include: Patrick Hennebelle (Paris Obs) in July, Phil Kronberg in August/September, Peter Kalberla (Univ. Bonn) in October/November and Ingrid Stairs (UBC, Vancouver) for an extended stay starting in September 2008.

The Distinguished Visitors program remains a very productive means of enabling collaborative research projects with local staff, adding substantially to the vitality of the ATNF research environment. For more information please see *www.atnf.csiro.au/people/distinguished_visitors.html* Prospective visitors should contact the local staff member with the most similar interests.

New ATNF postdoctoral fellows

Ray Norris, Jessica Chapman (ATNF)

Photo: Andrew Jameson (Swinburne University)

Emil Lenc

Photo: Mary Mulcahy

Michael Keith

We are pleased to welcome two new postdoctoral fellows to the ATNF.

Many ATNF staff already know Emil through his activities as a PhD student at Swinburne University, and through his expertise in imaging and wide-field VLBI. His PhD research involved the application of new wide-field, high spatial resolution radio imaging techniques to observations of starburst galaxies and radio galaxies. Emil joined the ATNF in January 2008 on a CSIRO Office of the Chief Executive (OCE) three-year postdoctoral position to work on the ATLAS project (*www.atnf.csiro.au/research/deep/index.html*) within the astrophysics group.

Michael arrived in February 2008, soon after completing his PhD, *Towards a Pulsar Virtual Observatory, at Jodrell Bank*. His pulsar research has focused on the discovery and timing of radio pulsars, and on developing pulsar processing software. He has now joined the ATNF pulsar group, as a Science Leader Postdoctoral Fellow, to work with Simon Johnston on a survey for pulsars using the Parkes radio telescope.

ATNF graduate student program

Bärbel Koribalski (ATNF)

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

- Shari Breen (University of Tasmania), *Masers as evolutionary traces of star formation,* with supervisors Dr Simon Ellingsen (UTas) and Dr James Caswell (ATNF).
- Rossa Hurley (Onsala Space Observatory), *Radio and millimetre observations of active galaxies,* with supervisors Dr John Convey, Dr Susannne Aalto (both Onsala Space Observatory) and Prof. Ray Norris (ATNF).
- Sui-Ann Mao (Harvard University), *Magnetic fields in the Milky Way, the Magellanic Clouds and beyond,* with supervisors Prof Bryan Gaensler (USyd), Dr Doug Finkbeiner (CfA) and Dr Naomi McClure-Griffiths (ATNF).
- Rajan Chetri (UNSW), *Study of the large-scale mass distribution in the Universe,* with supervisors Prof. John Webb (UNSW) and Prof. Ron Ekers (ATNF).

Congratulations to Haydon Knight on the successful submission of his University of Swinburne PhD thesis on *Pulsar Applications of Baseband Recording*, Steven Longmore on the successful submission of his University of NSW PhD thesis on *The Cradle of Galactic Superpowers - Studying the Natal Environment of Massive Stars*, and Ivy Wong on the successful submission of her University of Melbourne PhD thesis on *Star Formation and Galaxy Evolution of the Local Universe based on HIPASS.*

Steven is now in Boston (USA) at the CfA and Ivy is at Yale University (USA).

Articles

A(nother) radio-emitting magnetar

Fernando Camilo (Columbia University), John Reynolds (ATNF), Jules Halpern (Columbia University), Scott Ransom (NRAO), and Simon Johnston (ATNF)

Magnetars are the most strongly magnetized objects known in the Universe. Until 2006, none was known to emit radio waves. At Parkes we have recently discovered pulsations which suggest that perhaps any magnetar can be a radio emitter, at least occasionally. We have relied upon the great operational flexibility and superb capabilities of ATNF telescopes to establish the remarkable properties of these transient pulsations: e.g., with the Compact Array we have observed polarization at 45 GHz, a record frequency among pulsars.

Anomalous X-ray pulsars (AXPs) and soft gamma-ray repeaters (SGRs) are young neutron stars whose long rotation periods (2 – 12 s) are a result of ultra-strong surface magnetic fields ($B = 10^{14\text{-}15}$ G). Their large and variable X-ray luminosity is due to magnetic field decay, unlike the emission from ordinary pulsars that results from loss of rotational kinetic energy. Despite numerous searches, no radio emission had been detected from any of the dozen known magnetars, until in 2006 at Parkes we detected extraordinary pulsations from the 5.54 s AXP XTE J1810–197 (Camilo et al. 2006; October 2006 ATNF News).

Compared to ordinary pulsars, XTE J1810–197 has some unusual properties, such as a relatively flat spectrum over 0.3 – 144 GHz, and daily variability of pulse profile and flux. Also, as an X-ray magnetar it is unusual in being transient: it was identified in 2003 when its flux increased 100-fold after lying dormant for at least a quarter of a century. Apparently this outburst triggered the radio emission, which was not detected in the late 1990s. By early 2008, the X-ray emission has essentially returned to quiescence, and the radio emission is 100 times fainter than when first detected. Could it be that only transient magnetars emit radio waves?

On 7 June 2007, Gelfand & Gaensler (2007) reported in the astro-ph on-line archive their identification of the compact X-ray source 1E 1547.0–5408 as a magnetar candidate at the center of a supernova remnant candidate. On 8 June, while at Parkes, we modified the telescope schedule to observe this intriguing new target. A few days later we analyzed the 1.4 GHz search data and discovered P = 2.07 s highly dispersed pulsations from the direction of the magnetar. We soon determined that the period of this pulsar (PSR J1550–5418) was increasing at the huge rate of 2μs per day, implying $B = 2 \times 10^{14}$ G. Finally, on June 26 we made a Target-of-Opportunity (TOO) observation with the Compact Array, localizing the pulsar to within 0.1 arcsec of the position of the X-ray source. We had detected radio pulsations from a second magnetar (Camilo et al. 2007).

Through the southern winter and into spring we made numerous observations of PSR J1550–5418 with Parkes, the ATCA, the LBA, and the X-ray satellites *Swift* and *XMM-Newton* (with the latter we detected X-ray pulsations from this AXP). All of these were done under Target of Opportunity requests, which proved to be essential because by the next regular proposal deadline on December 15 the pulsar had decreased in flux and was no longer detectable at 1.4 GHz! In the meantime, however, we were able to begin to characterize its properties in some detail.

For instance, using nearly the entire complement of Compact Array receivers (including the new 7 mm system), we established that the flux density of the pulsar is roughly the same between 1.4 and 45 GHz, but shows time variability (Figure 1). At Parkes, using the flexibility provided by the ability to change receivers frequently, we obtained polarized profiles at 1.4, 2.3, 3, 6.4, and 8.4 GHz; with the ATCA we extended this to 18 and 45 GHz (see Figure 2). At frequencies above 3 GHz, PSR J1550– 5418 is nearly 100% linearly polarized, in this respect resembling some other young pulsars, as well as the first radio magnetar. Regular timing observations indicate that the torque operating on the neutron star varies greatly: as of late January, its characteristic age is P/2Ṗ = 0.9 kyr, compared to 1.4 kyr in June. Unprecedented among ordinary pulsars, this behavior has been observed in other magnetars and presumably reflects changing magnetospheric currents and field.

The new magnetar was not detected during the Parkes 1.4 GHz multibeam survey in 1998. However this does not mean that it is a radio transient in the same sense as the first radio magnetar. Since late November pulsations have not been detectable from PSR J1550–5418 at 1.4 GHz, but it remains observable at higher frequencies. With its flat spectrum and very broadened pulse at low frequencies due to extreme multipath propagation in the inhomogeneous interstellar medium, the magnetar is more easily detectable at high frequencies. (It was readily detected at 6 GHz in

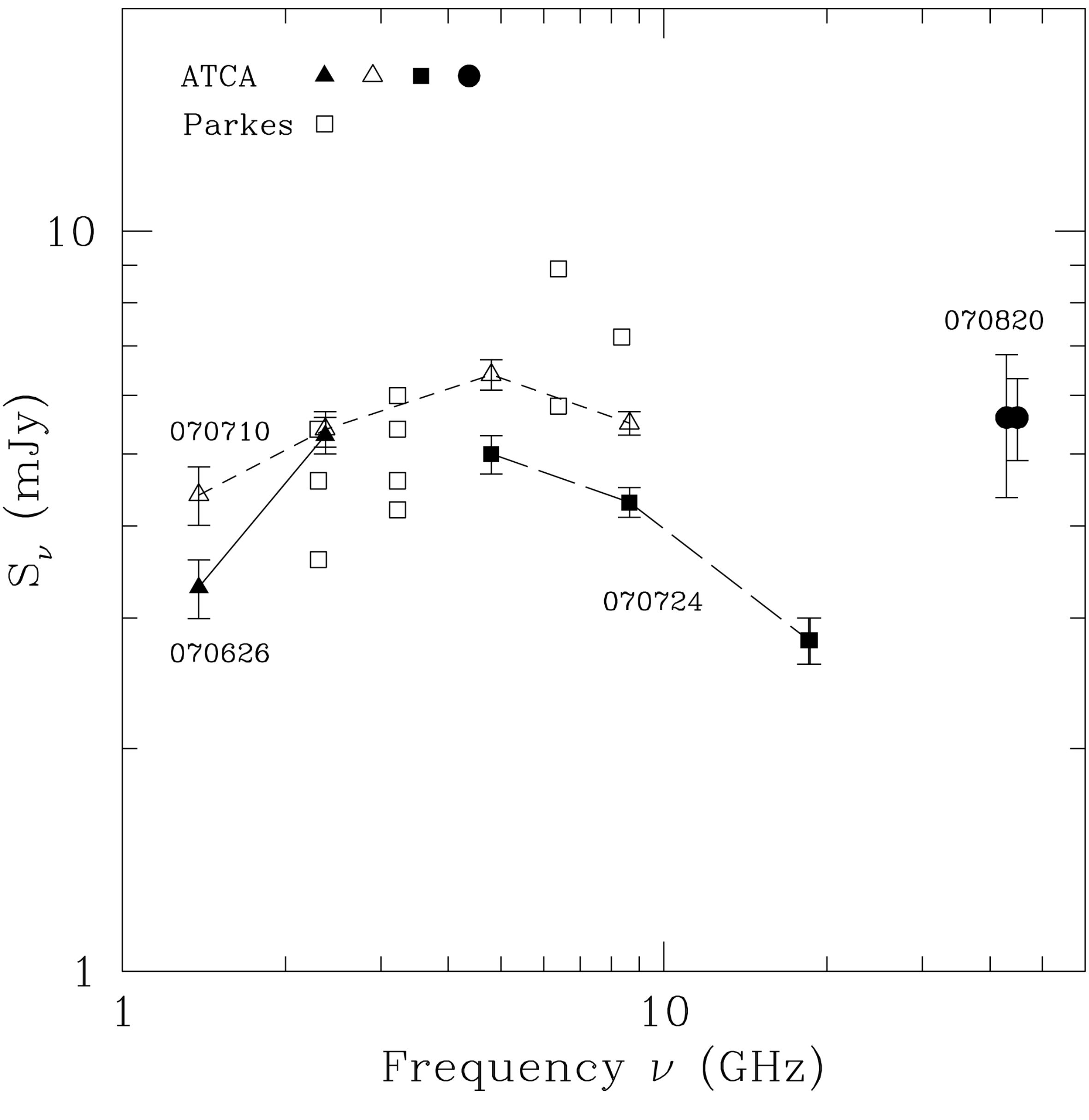

Figure 1: Flux densities of the magnetar PSR J1550–5418 at 1.4 – 45 GHz (Camilo et al. 2008). All points with error bars were derived from data obtained at the ATCA on four separate dates as labelled. Open squares represent measurements obtained at Parkes with a digital filterbank.

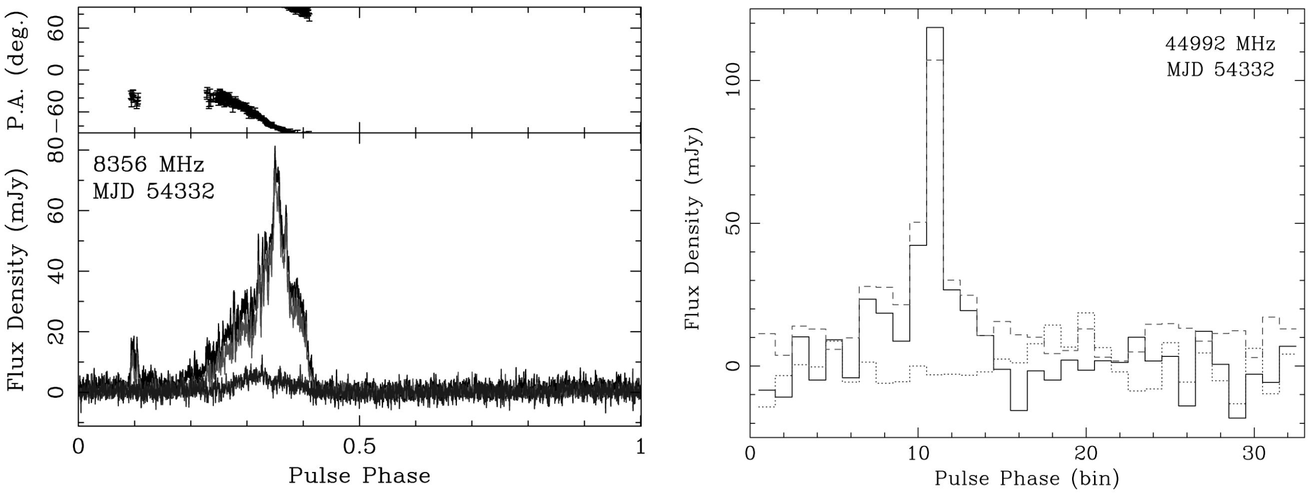

Figure 2: Polarimetric pulse profiles of the magnetar PSR J1550–5418.

Left: **8.4 GHz profiles obtained at Parkes using a digital filterbank. In the bottom panel, the traces from top to bottom represent, respectively, the total intensity and the amount of linear and circular polarization (Stokes parameters *I*, $L=(Q^2+U^2)^{1/2}$, and *V*). The position angles (P.A. = 0.5 arctan (*U/Q*)) are shown in the top panel.**

Right: **45 GHz profiles obtained at the ATCA on the same date (Stokes parameters *I*, *L*, and *V* are represented, respectively, by the solid, dashed, and dotted lines). The pulse is nearly 100% linearly polarized, like that at 8.4 GHz. This is the highest frequency at which polarimetric properties have been measured for a pulsar.**

April 2007 during the Parkes methanol multibeam survey.) From the X-ray variability data (Gelfand & Gaensler 2007; Halpern et al. 2008), it is also not clear that this is a true transient, and it may bear more of a resemblance to “persistent” AXPs.

Without any existing theoretical basis for excluding radio emission from magnetars (according to some theories they should not emit at all, but at least two manifestly do), it therefore seems reasonable to suppose that any magnetar could in fact occasionally emit radio waves. Why then have there not been more detections (at their peak, both pulsars are very luminous)? For PSR J1550–5418, the observed swing of the position angle of linear polarization as a function of pulse phase (see Figure 2) suggests (according to “rotating vector model” fits) that in this neutron star the rotation and magnetic axes are nearly aligned, and that its radio emission is only detectable within a small solid angle. If this applies to other magnetars (it does not to XTE J1810–197), then they could be radio emitters and remain undetectable from Earth. In addition, both known radio magnetars vary substantially in flux on a timescale of months.

For the time being, many of the radio properties of magnetars remain unexplained. To begin with, it is not understood why they emit at all. It is also surprising that for both of them the polarimetry data are consistent with emission within a dipolar magnetic field (magnetars are expected to have very convoluted magnetospheric geometries). The flat spectra are also puzzling. On the other hand, it is also not understood, 40 years after their discovery, why ordinary pulsars have steep spectra. The differences observed between the radio spectra of ordinary pulsars and magnetars could be important clues to both of their emission processes.

A fundamental property of radio magnetars, from the point of view of detectability, appears to be their great variability. We don’t know how many more there could be in the Galaxy (nor, therefore, what their possibly substantial birthrate is). More generally, these and other recent discoveries of transients are a reminder of how poorly we have sampled the variable radio sky. We have just begun to explore this vast unknown with the excellent telescopes that we do have. We hope that this unique existing capability will be cherished, as we look forward to the next generation of planned wide-field radio telescopes.

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Three-millimetre line surveys with Mopra

Andrew Walsh (JCU, UNSW), Sven Thorwirth (MPIfR), Gunnar Hurtig III (JCU), Michael Burton (UNSW)

High mass star formation processes in our Galaxy are often difficult to study. They are typically enshrouded in their natal molecular cloud, making them impossible to observe in the optical. They are intrinsically rare, with perhaps only one in a million stars in our Galaxy of suitable mass. They also form so quickly (in about one hundred thousand years) that they are hard to catch in the act. Nevertheless, they are fascinating objects, as they show the brightest and the richest millimetre (mm) line spectra in the sky, as identified in line surveys (eg. Turner 1989).

Line surveys involve observations typically at mm or sub-mm wavelengths covering entire spectral windows many GHz wide. These surveys detect many spectral lines within these windows. For example, nearly twenty years ago the survey by Turner (1989) of the brightest line sources in the sky (Orion-KL and Sgr B2) covered the 3 mm window and detected 755 lines in Orion-KL and 641 lines in Sgr B2. Since then, line surveys have progressed to a stage where most of the mm/sub-mm spectrum has been observed towards at least one source (Orion-KL), with many thousands of lines identified, coming from over 150 different molecules, ions and radicals.

Such work has taken many accumulated weeks of telescope time. This is because traditional spectrometers have only had the capacity to observe a small part of the spectrum at any one time: bandwidths were typically 128 or 256 MHz. With a 256 MHz bandwidth, over 150 observations are required to cover the 77 – 116 GHz frequency range of the 3 mm window. This necessarily limits the amount of spectral line work that can be carried out.

The Mopra radio telescope has recently received a new spectrometer, called the Mopra Spectrometer (MOPS). It has an instantaneous bandwidth of over 8 GHz. For line surveys this means Mopra can now survey thirty times faster, covering the 3 mm window in as little as five observations!

With this new capability, it is possible to tackle scientific questions that were previously not feasible. For example, within a class of objects, it is very difficult to find a “typical example” - an individual source that typifies the class. Individual sources nearly always have their own peculiarities. This is especially the case in line survey work where Orion-KL and Sgr B2 have been intensely observed. Neither of these two sources is considered a typical example of a high mass star forming region. Orion-KL, the nearest region of high mass star formation to us, shows line spectra with unusually strong emission in sulfur-bearing species, most notably SO and SO_2. It is also the only known region of high mass star formation that exhibits SiO maser emission. Sgr B2, on the other hand is located very close to the centre of our Galaxy, putting it much further away and yet it is still one of the brightest line sources in the sky. The line emission is typified by line widths around 20 km s^{-1}, whereas most other high mass star forming regions have line widths of only 5 km s^{-1} or less. If we really want to understand high mass star formation in general terms then it is clear we need to look at more regions to sample a broader base of conditions. This is now possible with Mopra.

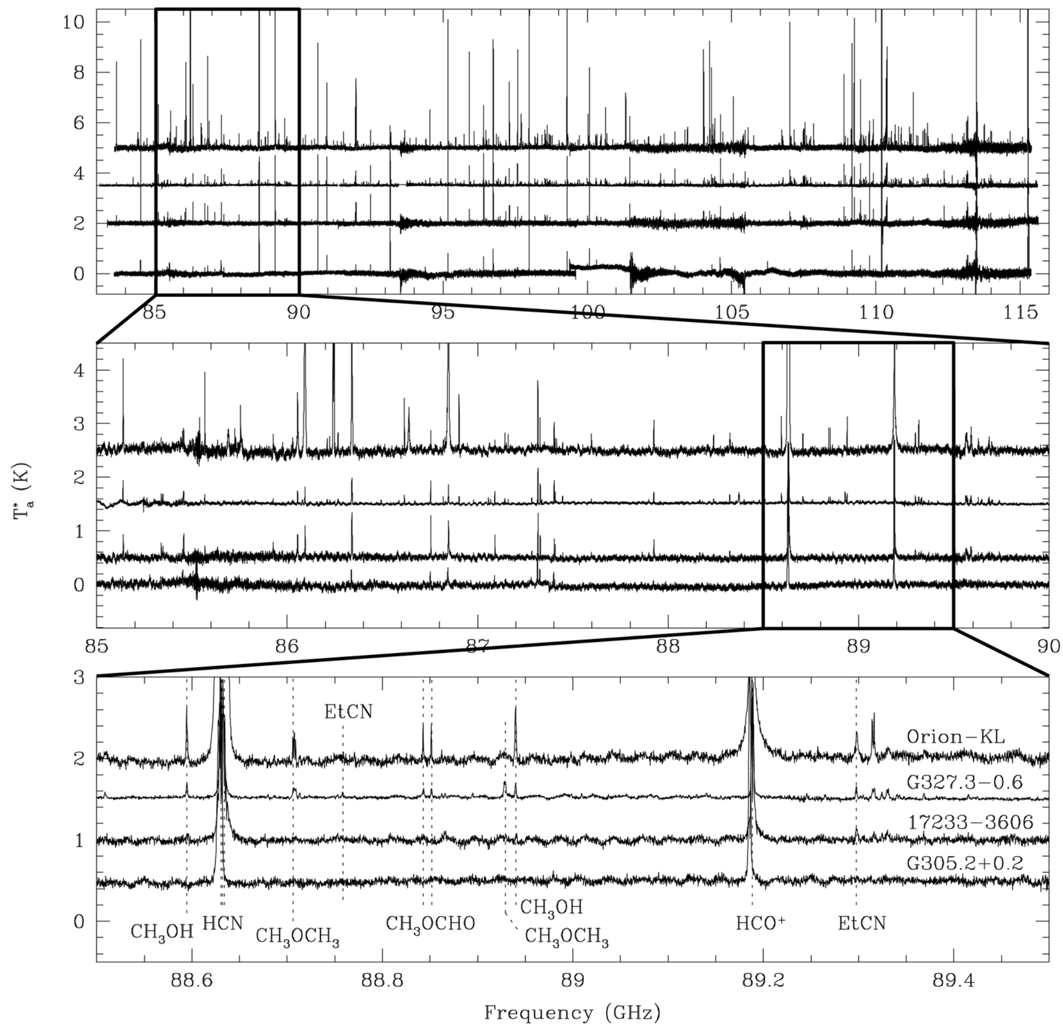

Figure 1: 3 mm spectral line surveys of four regions of high mass star formation. In each frame from top to bottom the spectra are Orion-KL, G327.3–0.6, 17233–3606 and G305.2+0.2. The top frame shows four out of the five frequency settings, covering over 30 GHz of frequency space. Each narrow spike in these spectra corresponds to an emission line from a molecule, ion or radical. The middle is a zoom into a 5 GHz section, where many individual lines can be identified. The bottom frame is a zoom into a section of the middle frame, where the stronger lines have been identified. The two strongest lines in this frame (HCN and HCO+) clearly show evidence for line wings due to outflow activity in all four regions.

Observations were made in July 2006 and consist of simple ON-OFF observations made by position switching from source to a nearby reference position, devoting equal time to ON-source and OFF-source. There was a total of 10 minutes integration time per spectrum. Five frequency settings were used to cover the 3 mm spectral window from 75.4 – 115.6 GHz. Thus, the time required to observe one region was just under one hour. During the observing run, 60 regions were observed.

Figure 1 shows line emission across most of the 3 mm spectral window (four out of five frequency settings) towards four regions of high mass star formation. As can be seen from the complexity of this figure for just four regions, it is not possible to display all 60 regions and retain much information on individual spectral lines. The Figure shows a vast number of spectral lines detected in each region. There are many lines that are common to all regions, such as HCO+ and HCN, shown in the lower blow-up frame. It can also be seen that both of these lines show broad bases in each spectrum. This is indicative of outflows associated with the star formation process.

Careful inspection of the spectra shows some differences between the relative strengths of the lines. As previously mentioned, many of the strong lines that appear in Orion-KL (top spectrum) that do not appear so strong in the other regions are due to SO or SO_2. This is due to unusual sulfur chemistry in Orion-KL. The lower frame in Figure 1 allows us to directly compare relative strengths of some individual lines. What is apparent is that whilst Orion-KL shows the strongest lines overall, there are some subtle differences that might shed light on the physical differences between the regions. At 88.931 GHz the spectrum shows a clear detection of a line, but this line does not appear in any other region, including Orion-KL. The most likely identification of this line is dimethyl ether (CH_3OCH_3). The dimethyl ether line occurs at 1059 K above ground state. So if this line does come from dimethyl ether, then it is a clear signature of a significant high temperature component in G327.3-0.6 that is not present in the other regions. Other parts of the spectrum give us other insights into the characteristics of each region: diazenylium (N_2H^+) at 93.173 GHz is an ion that is found in some of the coldest and densest regions (Walsh et al. 2007), where the initial collapse stage of star formation is thought to occur; methyl cyanide (CH_3CN) at 110.353 GHz is a useful probe of both temperature and density (Purcell et al. 2006); comparison of H_2S, SO and SO_2 can tell us about the age of a region as H_2S is present at the early stages but is quickly processed to SO and SO_2 (Charnley 1997). In addition to these insights from individual, or small groups of lines, it is hoped that the great wealth of line information can be used to form a detailed and complex model of star formation in each region

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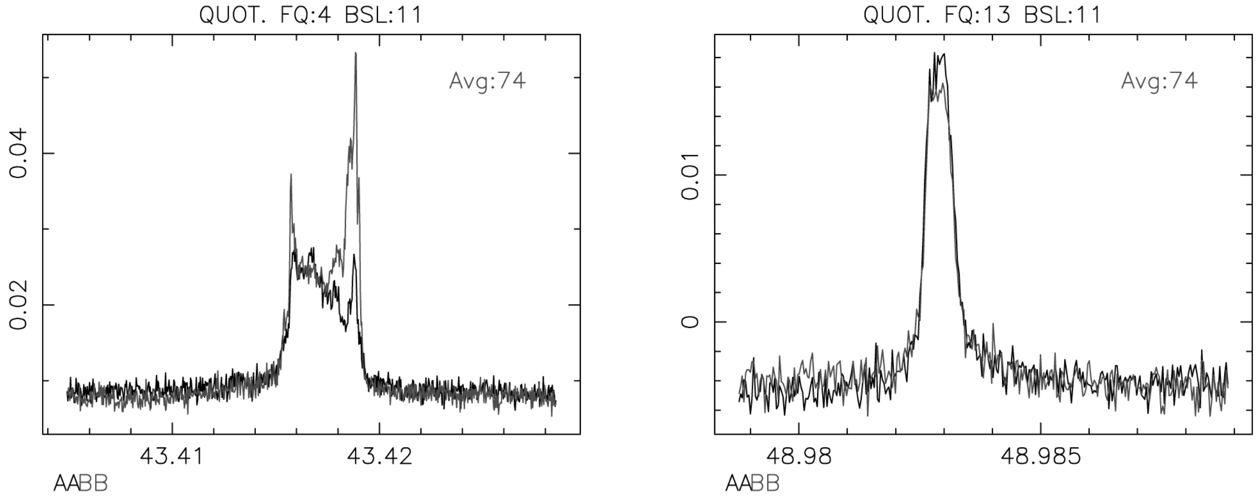
Regular items

Compact Array and Mopra report

Phil Edwards (ATNF)



First light with the Mopra 7-mm receiver obtained on 12 February 2008, from observations of SiO masers in Orion made by Warwick Wilson.

It has been a busy start to the year. Rudi Behrendt retired in December, and in January we bid farewell to Michael Laxen, who has taken a position with CARMA. The Mopra telescope was shut down over the summer to enable work to be carried out on the Uninterruptible Power Supply (UPS) and to add a 7-mm receiver to the Mopra suite. A number of small but frustrating problems were encountered on restarting the system, and Mopra only managed to join the first Long Baseline Array session in February thanks to some long hours put in by staff.

No sooner was Mopra operational than the Compact Array developed serious problems, which were quickly traced to galahs developing an appetite for the cables running between the vertex room and pedestal room. Spare cables were patched in at short notice to keep the array almost fully operational, and maintenance blocks have subsequently been used to take the most badly affected antennas off-line for a week to replace the damaged cables.

Narrabri systems and developments

Preparations for the installation of the Compact Array Broadband Backend (CABB) interim system are proceeding. It is anticipated that an interim CABB system comprised of five antennas outfitted with a capability for single frequency operation will be available by July 2008. Initially the CABB backend will be available for five antennas and the 3-, 7- and 12-mm receivers only, with bandwidths up to 2 GHz. This will allow parallel operation of the current system and the interim CABB system. An Observatory shutdown to remove the existing backend and to install the full CABB system will take place late in the October semester.

The Compact Array seeing monitor uses two 1.8-m dishes pointed at a geostationary satellite. This has operated since May 2004 and has provided a valuable measure of atmospheric stability. Late last year Optus started migrating the satellite to a new position, a process which took about a month, and so the monitor dishes required repointing every couple of days. Longer term, the current 30 GHz beacon will become unavailable, and efforts to upgrade the seeing monitor to operate using a 20-GHz beacon are well advanced.

Spacecraft tracking

Engineering tests are continuing for NASA, both tracking the 32-GHz beacon on the Cassini spacecraft, in orbit around Saturn, and in receiving downlink telemetry in the 8-GHz band from satellites orbiting Mars. For the April semester the commitment to NASA tracking is about 10 hours per month, but it is anticipated that the launch of the Kepler spacecraft early next year will see the allocation for tracking increase to something approaching the nominal average of 10 hours per week.

Mopra developments

Over the summer, Mopra was outfitted with a 7-mm receiver. Jock McFee spent a number of weeks at Marsfield helping add the 7-mm receiver to the millimetre dewar, and then at Mopra for installation and testing. The 30 – 50 GHz band can now be studied with the 8-GHz bandwidth of MOPS, with an important caveat: the centre of the 8 GHz band must lie within the ranges 34 – 38 GHz or 44 – 46 GHz. It is not possible to have an 8 GHz band centred between 38 and 44 GHz.

The HOPS (H_2O southern galactic Plane Survey) team undertook a pilot study last summer and demonstrated that observing at 12 mm over summer nights could be carried out productively. This summer the team observed over 45 nights and were very pleased with the results, with less than three per cent of the time lost to weather and only a few technical hiccups at the beginning of the run.

The HOPS team have been the first to benefit from the Telescope Operator Alerting Device (TOAD), a software package similar in some respects to the Compact Array program ASSISTANCE, but covering many Mopra specific conditions and engineered with human factors requirements in mind. TOAD, developed by Balt Indermuehle, keeps tabs on the status of several hundred telescope, network, and computing parameters and both alerts observers to any abnormal state and provides suggestions as to how to recover without staff intervention.

Mopra Training Day

A Mopra Training Day was held on 25 March at the ATNF Headquarters in Marsfield to introduce new users to observing procedures (schedule files, observing, monitoring and data reduction), create a forum for discussion amongst ATNF staff and expert Mopra users, and increase the information available by encouraging the speakers to document their Mopra knowledge in the form of powerpoint slides and tutorial hand-out sheets.

The day, organized by Kate Brooks and Balt Indermuehle, was very successful, and all presentations and tutorial material are available on the web at www.narrabri.atnf.csiro.au/mopra/ProgramTrainingDay.htm. Consideration is being given to running a smaller version of the training day later in the year at Narrabri.

Environmental issues

During a visit from Geoff Garrett, the Chief Executive of CSIRO, to Narrabri last year, the question of CSIRO embracing an environmentally friendlier approach to its own workplace was raised, and Geoff and Lewis Ball enthusiastically endorsed the idea. Several projects have been funded across the ATNF to put this into action. At Narrabri, an electric golf cart has been purchased to minimize the use petrol-powered vehicles for short trips to and from the antennas. A solar powered station is being developed to help "refuel" the cart.

A new waterless, composting toilet will be installed at the Visitors Centre and housed in a "demonstration" energy efficient amenities block. Detailed design is currently being undertaken by a Tamworth based architect and site staff.

The site's water supply has been upgraded to meet the recommendations of a report on the site's fire-fighting capacity. The new tank and pump system will enable a flow at the fire hydrants to meet the Australian Standard. Additional rain water tanks have also recently been installed to enable collection of up to 100,000 litres to supply the site.

Time assignment information

Philip Edwards (ATNF)

Preparing a proposal

The Time Assignment Committee (TAC) met at the end of January 2008 to review and grade a record number of proposals for the 2008APRS semester. A total of 231 proposals were discussed, about 60 more than for the previous winter semester. To help the TAC members with their large reading load, in this issue we remind proposers of some of the rules and guidelines for writing and submitting proposals.

First, take the time to re-read section 4 of the *OPAL Users Guide*. This lists the science case requirements and provides some useful recommendations from the TAC. Read these at least a week before the proposal deadline! The guide is available at *http://opal.atnf.csiro.au*.

For most proposals the scientific case *must not* exceed three pages in total, including figures and references. The temptation to reduce the font size to meet the three page limit should be avoided: an 11-pt font is the preferred minimum size. Please use standard fonts and check that their conversion to pdf for submission has not rendered the text unreadable. If in doubt, try viewing your pdf on a computer running a different operating system to ensure compatibility. Figures should be in black and white as the proposals are photocopied for distribution to the TAC members. Figure captions which refer, for example, to red lines or blue points are frustrating for TAC members.

The exception to the three-page limit is for Large Projects, defined as projects which will require a total observing time of more than 400 hours. For the initial proposal submission, large projects have, in addition to the usual three-page limit for scientific justification, an additional two pages to be used for defining data analysis and timeline plans, data release plans, and a recommended public outreach plan. Additional figures supporting the scientific justification can be included within the two additional pages if desired.

For the OPAL Observation Tables, you should include any overheads in the proposed observations (for pointing, or calibration, or insurance against bad weather). Overheads are recognised as a necessity for observing. Add the time needed for these to the "integration time" field. It is not necessary to list the calibration sources separately in the observations table (though you may wish to mention them in the science case). The requested time for the observing semester given on the cover sheet should be the same as that calculated by the observations table, and these should agree with the time stated in the science case! Note that, including overheads, the integration time may not be able to be used on its own to calculate the expected sensitivity: if this is critical to the proposal it should be spelt out in the science case.

Now for acronyms: while the ATNF TAC knows its ATCA from its ALMA, its DFB from its PRB, and its VLA from its TLA, it's unwise to assume that the TAC are familiar with every cherished acronym in your field of study. The proposal should be written in clear English and aimed at an astronomer who is a non-expert in your particular field. Always aim for clarity. Having written your proposal, read it carefully through one last time before submitting it. Even better, get a colleague to read it.

As a general rule, always aim for clarity. Well-written proposals that are well laid out with clear diagrams and figure captions, and strong science cases, are a pleasure to read and are graded accordingly.

ATNF publications list

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

This list includes published refereed papers compiled since the October 2007 Newsletter. Papers which include ATNF staff are indicated by an asterisk.

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ATNF outreach

PULSE@Parkes project launched by Minister Carr

Robert Hollow (ATNF)

The Minister for Innovation, Industry, Science and Research, Senator Kim Carr, officially launched the PULSE@Parkes project at the CSIRO Discovery Centre, Canberra on 18 December 2008. This followed the successful first trial with students from Kingswood High School on 4 December.

Senior high school (years 10 and 11) students took control of the Parkes radio telescope via the internet from the lecture theatre at Marsfield. They observed several pulsars whilst talking with Dr George Hobbs who was in the control room at Parkes. Their analysis yielded pulsar dispersion measures and distances that agreed closely with published values.

Following the second trial with students from Muswellbrook High School on 13 February the project was opened to applications from all schools in March. Selected schools will be able to visit Marsfield for remote observations while all of the project materials will be freely available online for others to use.

The students' observations will be added to an archive and will contribute towards ongoing pulsar projects at ATNF. Collaboration with US students involved in the Arecibo Remote Command Center (ARCC) is also planned.

For more information visit the project webpage:

http://outreach.atnf.csiro.au/education/pulseatparkes/

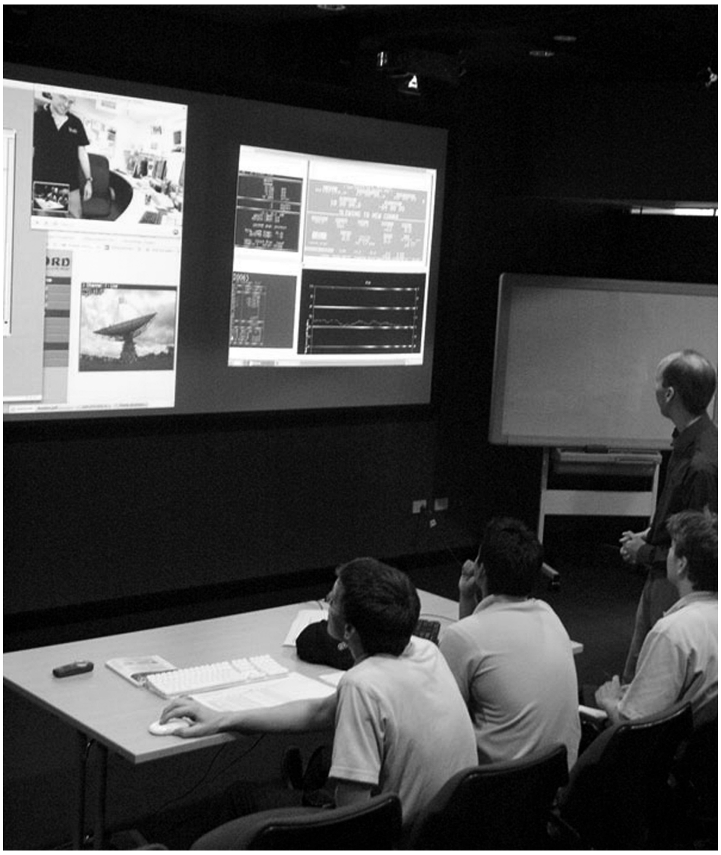

Photo: Robert Hollow

Students from Kingswood High School during the first PULSE@Parkes test, 4 December, 2007.

My experience as an ATNF summer vacation scholar

Minnie Mao (ATNF summer vacation student 2007/2008)

I was ecstatic to find out I had been offered a summer project at the ATNF this summer. The project I had been offered, *Finding the First Black Holes in the Universe* (with Ray Norris and Ilana Feain), required observations both on the Anglo-Australian Telescope (AAT) and the Compact Array (ATCA). I couldn't wait to play with these big telescopes!

I spent only four days at Marsfield before being whisked away to the Siding Spring Observatory. The week we spent observing on the AAT was crazy fun, despite more than half our time being fraught with cloud. Observing would start with watching the sunset from the catwalk then we would retreat into the control room to set ourselves up. I got to reduce data as we obtained it – I got such a kick out of seeing spectra from galaxies that were more than half the universe away!

It was upsetting to leave the AAT – I'd had so much fun, how could the ATCA beat that? I was in for a surprise. Observing at the ATCA was awesome! I loved watching the 'scopes slewing, and knowing that it was slewing under my command – all 6 km of it! Ah sweet power trips. Observing at the ATCA also proved to be extremely educational. Only after being onsite and seeing the distances between the 'scopes did it all become real for me. The onsite staff, other observers and the various duty astronomers that were there during my month at the ATCA were all lovely and more than happy to explain things to me. The site also had beautiful walkways and bike paths which I explored daily. For me the ATCA yielded the perfect mix between work and play.

On the way back to Marsfield from the ATCA we stopped at Parkes to see the telescope (the Dish). Nothing can compare with being on site and seeing the sheer size of the Dish balanced up above the control room. I was very excited when the observers allowed me to push the green button. As luck would have it we were there on a day scheduled for maintenance so I got taken up to the focus cabin and given a dish ride down. The view from the focus cabin really was something – and I felt like quite the celebrity as later on in the Visitors Centre there were tourists who came over to tell me they'd seen me on top of the focus cabin!

Back at Marsfield I was once again touched by just how amiable everyone was. Every single person I spoke to made time to chat and answer questions.

The highlight of the summer program was the observing trip to Narrabri. We split into three groups and each group was allocated 12 hours. For most of us it was the first time obtaining data of our very own!

Between observations we also managed to play with Balt's 25 inch reflector, visit the solar observatory and visit the Sydney University Stellar Interferometer (SUSI) (although one of the boys almost missed out as he thought we were visiting a 'hot blonde'). We had so much fun that we all ended up quite sleep deprived as we just didn't want to miss anything! (Although we probably weren't quite as sleep deprived as our duty astronomer, Simon Johnston.)

The ATNF Summer Program was an absolute blast for all of us lucky ducks (or chickens as Anita might say). Special shout outs to the supervisors for their everlasting patience, Rob Hollow, Angel Lopez-Sanchez, Erik Muller and Simon Johnston.

2007 summer vacation scholarship program

Robert Hollow (ATNF)

The 2007 ATNF Summer Vacation Scholarship Program involved eight undergraduate students undertaking a project supervised by ATNF staff. Projects ranged from astrophysics, engineering, software development and outreach. The program ran from late November through to early February 2008.

All the students also took part in an observing trip to Narrabri to use the Compact Array. Split into three groups, each group developed a project for a twelve-hour observing run on the Compact Array.

The student symposium and lunch in February at Marsfield concluded the program. This year the symposium was combined with the summer students from the AAO. Each student presented the results of their project and responded to questions from the interested audience.

Photo: Robert Hollow

2007 summer vacation scholars at Narrabri. From left to right: Chritoph Brem, Minnie Mao, Vikram Ravi, Matt Carr, Eranthie De Silva, Anne-Marie Brick, Anita Titmarsh, Abhinay Mukunthan with supervisors Erik Muller and Angel Lopez-Sanchez.


The Parkes radio telescope

Photo: Michael Dahlem

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