Newsletter 4

December 2010

PI Report

Tara Murphy and Shami Chatterjee

The first year of the ASKAP Design Studies ended with the Survey Science Teams Working Meeting held at the end of November. This was extremely productive and it was interesting to find out what the rest of the teams were doing. If you weren't able to make the meeting in person, the key presentations are available online on the ATNF Redmine wiki.

http://pm.atnf.csiro.au/askap/wiki/sup/Wiki_sup_meet_workshop_1

Shami specifically adds, "At the ASKAP Science Workshop, the ATNF Director Phil Diamond pointed to VAST as the exemplar of a well-run SSP, and Tara was specifically called out for her effective management of the project. Please join me in congratulating her and making sure she never lives this down. Congratulations, Tara!"

Thanks to everyone for your contributions in 2010. Looking forward to a fun a productive 2011, and in particular to the first data from BETA!

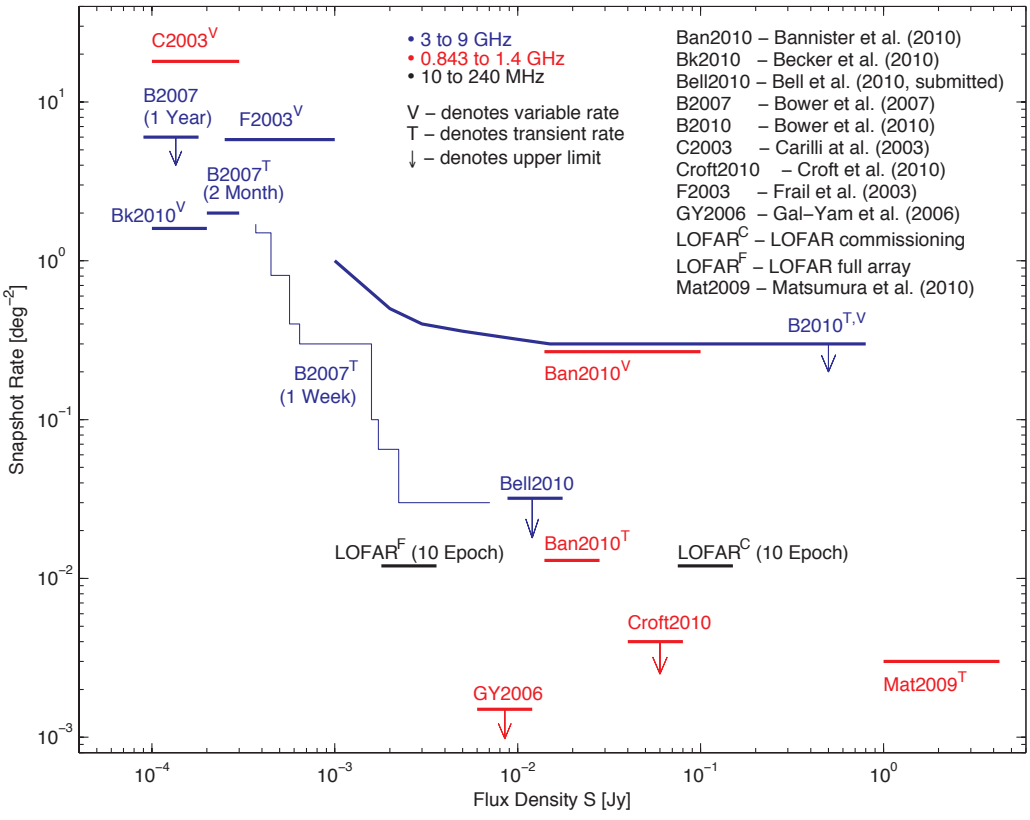
Science Report

VLA transients search

Martin E. Bell, R. P. Fender, J. Swinbank, J. C. A. Miller-Jones, C. J. Law, B. Scheers, H. Spreeuw, M. W. Wise, B. W. Stappers, R. A. M. J. Wijers, J. Hessels and J. Masters.

In a recently submitted paper we present the results of a blind survey for radio transients using data obtained from the VLA archive. We have reduced, using a pipeline procedure (ParselTongue + AIPS), 5037 observations of the most common pointings - i.e. the calibrator fields. The observations used span a time range ~ 1984 - 2008 and consist of eight different pointings, three different frequencies (8.4, 4.8 and 1.4 GHz) and have a total observing time of 435 hours. The average integration time spent on all fields was $\langle\tau\rangle$ = 5.2 minutes. We have searched for transient and variable radio sources within these observations using components from the LOFAR transient detection algorithms.

Right: Snapshot rate vs flux density of detections of transients ('T'), variable sources ('V') and upper limits based on non-detections. The plot contains results published in the literature and on-going work. We note that this plot does not contain any information on characteristic time duration and recurrence of transient behaviour as both are currently poorly constrained.



The aim of this work and paper is to deepen our understanding of the GHz transient sky within the framework of testing and refining the transient detection algorithms, that will operate on the LOFAR radio telescope (Fender at al. 2008). As LOFAR moves towards a completely automated system – which will include flagging, calibration, imaging, source extraction and transient detection – end-to-end testing of this "pipeline" must be performed to reduce the number of false positives. We use the abundance of observations in the VLA archive to further this goal and we also consider the statistical implications of our results.

No radio transients were detected in this survey, therefore we place an upper limit on the snapshot rate of GHz frequency transients > 8.0 mJy to $\rho < 0.032$ deg^{-2} that have typical timescales 4.3 to 45.3 days. In the figure above we compare this result with previous published detections of transient and variable radio sources (and upper limits derived from non-detections). The upper limit derived from this study is consistent with the detections reported by Bower et al. (2007), and also the recent results of Bannister et al. (2010) and Bower et al. (2010). Note, our survey was not sensitive to variable radio sources, therefore we only compare transient rates. We might have possibly expected one transient detection (based on the Bower et al. 2007 results) at our flux density thresholds, assuming that the transient population sampled is isotropically distributed.

In the figure we also include a limit based on on-going work with LOFAR commissioning data. We have obtained 10 repeated observations (12 hours each at 150 MHz) of the same field, sampling a field of view of 25 deg^{-2}, with a cadence approximately weekly.

Our aim is to sample the sky with a similar cadence to the Bower et al. (2007) study to compare the GHz and MHz population of transients, at that cadence. The image fidelity is currently looking extremely promising and we hope to publish some early results in the new year.

Further experiments with LOFAR and indeed other next generation wide-field facilities will push deeper into the parameter space available. By sampling the sky at variety of cadences the dominant transient source populations can be effectively studied.

Profile – Duncan Galloway

Duncan is an ARC Future Fellow at Monash University. He is the chair of VAST WG7.

What are your main research interests?

Behaviour and properties of accreting neutron stars. I am interested in the properties of pulsations in low-mass X-ray binaries, including persistent and intermittent pulsations, and also burst oscillations. These sources are candidates for gravitational wave detection with LIGO, and I've recently commenced a project to measure orbital parameters through optical spectroscopy and hence improve the sensitivity of current and future GW searches. I'm also working on the physics of thermonuclear bursts, and extracting neutron star parameters from observations of bursts. Many accreting neutron stars are also transients, and I'm interested in a general sense in discovery and prompt characterisation of new transient sources.

What papers are you working on at the moment?

I am working on one paper testing blackbody models on a large (several tens of thousands) of low-resolution X-ray spectra from thermonuclear bursts. I'm also trying to finish a paper presenting a new method to measure surface gravitational redshifts for neutron stars using bursts.

What excites you about ASKAP?

Firstly the opportunity for discovery of entire new classes of transients; but also the chance to learn more about radio astronomy, which is not a field in which I have much (any) experience!

What is the main challenge for Working Group 1?

Keeping track of all the various projects that the many VAST members are involved in! But also ensuring that we are doing all we can with the presently available observational & archival data to (amongst other things) constrain our event rates and refine our source characterisation procedures.

What do you enjoy outside astronomy?

Cycling, reading (fiction instead of papers and proposals!), music, travel, and of course spending time with my wonderful family.

Working Group Reports

WG1 – Simulations and Imaging

Randall Wayth

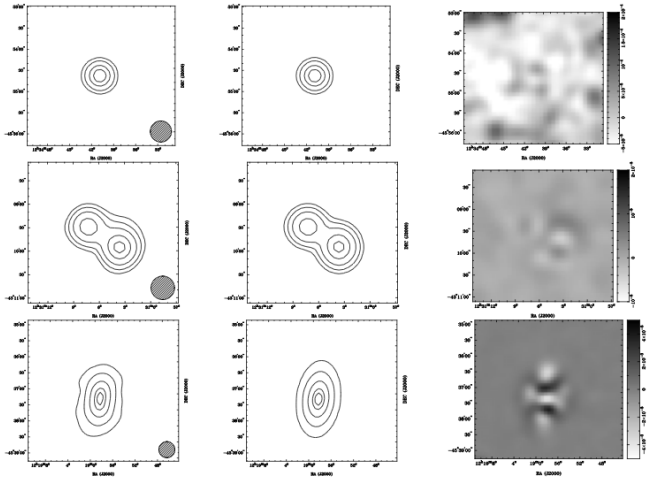
2010 has been a successful year for WG1 culminating with the release of ASKAP simulations that include variability of compact radio sources due to interstellar scintillation as well as a population of extreme scattering events. We are working to expand the types of sources included in the simulations and the next round will contain a population of x-ray binary sources. In 2011, WG1 aims to complete the complement of source populations including variable/flare stars, AGN variability, nulling sources and other exotica. As WG1 chair, I'd like to thank all the active and contributing members of WG1 and the ASKAP simulation and imaging team for their great work.

WG2 – Source Finding

Tara Murphy

We have made good progress in source finding in 2010. The main output from our work so far will be a paper evaluating current source-finding approaches and the strengths and limitations of each. The figure below shows some examples of source fitting using a two-stage process with `sfind` and `imfit` from Miriad.

We will also provide feedback to the ASKAP computing team on how the existing continuum source-finder (Duchamp) needs be improved to satisfy the requirements of a real-time pipeline.



Performance of sfind + imfit fitting on 3 archetypal sources. The left panel shows the original object. The centre panel shows the model fit with the same contour levels. The right panel shows the residual image after source subtraction (note the greyscale has been chosen to emphasise the residual flux).

WG3 – Survey Strategy

Shami Chatterjee

The word of the month for WG 3 was "dithering". Specifically, the focal plane array has non-uniform sensitivity across the field of view, and to achieve uniformity, observations will be continuously dithered. For VAST, that will probably result in some reduction of detection sensitivity for transient events with a characteristic timescale comparable to the dithering time. The issue was discussed in Cross-SSP WG 3 telecons, and our initial conclusion was that VAST could live with electronic dithering on ~5 to 10 second timescales. The specifics of the ASKAP observation strategy are still in flux, but all VAST members should be aware of dithering and the issues that may create.

WG4 – Hardware and Commissioning

Simon Johnston

The ASKAP Project Scientists have designated two fields for `First Science' with BETA. The fields are centered on the Circinus Galaxy (RA 14:13, Dec -65:20) and the Fornax Cluster (RA 03:30, Dec -36:08). In 2011, characterisation of these fields will be undertaken with the ATCA using the wideband L/S receiver and CABB. Two weeks of time have been allocated, one week with the 750B array and one week with the 1.5B configuration. A large mosaic of 300+ pointings will be used to cover the 30 square degree field of view of BETA.

Interested parties can sign up for projects via the Redmine page

http://pm.atnf.csiro.au/askap/wiki/sup/Wiki_sup_wg4b_atca

Of particular interest to VAST is the possibility of locating transients and monitoring variability of sources in the field over the two week timescale of the observations. At a lunch time meeting in Sydney on December 1, the VAST team members present considered submitting a separate ATCA proposal to monitor the fields over 6 months on top of the observing already planned. After much discussion, it was decided not to proceed with a separate proposal.

WG5 – Data Format and Access

Hayley Bignall

The main achievement of WG5 for 2010 was to produce an initial document describing VAST data requirements. This will be updated following feedback provided by the ASKAP Computing

Group to the Survey Science Teams, and a description of the planned high-level structure of ASDAF and the Data Level Model presented by Emil Lenc at the recent Survey Science Teams Working Meeting. We have also started to develop use cases for interaction with the ASKAP VAST archive, which will be further developed in 2011. The other main task of WG5 in the new year will be to evaluate existing VO tools and determine their suitability for VAST archive access.

WG6 – Transient Detection Pipeline

David Kaplan

Members of WG6 are working hard to use early MWA data to detect/constrain slow transients at low frequencies. We took a lot of data during a recent MWA expedition, and have been developing software and algorithms to efficiently process it. The data are of quite high quality, and we can see sources over more than 60 degrees of the sky. There are still problems with the data, and we are working actively to try to understand the best calibration and analysis techniques. We are hopeful that if we can work out some remaining issues the MWA data will make a valuable addition to the slow-transient literature and will give us experience relevant for VAST.

WG7 - Ongoing Science Projects

Duncan Galloway

An NSF proposal (PI: Chatterjee, with Kaplan, Bower, Cordes & Frail) to study transients in the VLA archive was approved this month. Some members of WG7 met in early November at U. Sydney to discuss our procedures for reporting new transients. We plan to develop a process to promptly characterize new transients that will make it possible to filter the events that are sent out to the broader community. At the SSP meeting in November there was some discussion of the planned ATCA observations of the proposed BETA fields, and how well these observations would serve as a baseline for variability of sources in the fields. It was agreed that there was insufficient motivation to propose for additional observations. Keith Bannister presented his work on the MOST transients, which is now complete, and he has just completed a series of follow-up observations with ATCA. There has also been some progress on SKAMP commissioning, with the official handover of the digital system from CSIRO to USyd. We hope to have several new staff working on this in 2011, and hence be taking data by late 2011.

News and Updates

VAST Memo 3 published

The third VAST memo had now been published on our website by Stuart Ryder.

"*Simulating radio light curves for supernovae in VAST*"

VAST will provide the first unbiased census of core-collapse SNe, by allowing us to match radio detections against optically-discovered SNe. We should also detect new radio SNe that may have gone undetected in the optical or infrared due to significant amounts of dust (Kankare et al., 2008). Every new SN discovery is valuable for tying down the current rate of massive star formation in the Universe and for understanding how and when SNe explode in star-bursting galaxies. Core-collapse SNe "turn on" within days, and reach their peak luminosity at 1.4 GHz as much as one year after explosion, typically ~1 mJy at a distance of 50 Mpc (Gal-Yam et al., 2006), making them ideal targets to study with the sensitivity and cadence of VAST. With our planned survey, we would expect to detect ~ 1 SN per month.

ASKAP at the AAS

Ilana Feain

There will be an ASKAP presence at the AAS in January 2011 and we invite you to come and find us and get updated on the project. There will be a booth set up and (wo)manned by at least 3 ASKAP staff members.

We are also holding a splinter meeting on January 10 as follows:

- *An Update on Australian SKA Pathfinder*
- Aspen Room, Sheraton Hotel
- Mon 10 Jan, 6pm – 8pm.
- There will be a bar set up (with a modest bar tab) and some finger food provided.

Please come along to the booth and the evening splinter, encourage others to come along too, both to mingle and get updated on the project.

Upcoming Meetings

Supernovae and their Host Galaxies

Powerhouse Museum, Sydney 20 to 24 June 2011

http://www.aao.gov.au/southerncross