

THE AUSTRALIA TELESCOPE NATIONAL FACILITY

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(Received November 30, 2014; Revised May 31, 2015; Accepted June 30, 2015)

ABSTRACT

The Australia Telescope National Facility (ATNF) consists of the Parkes and Mopra radio telescopes, and the Australia Telescope Compact Array, with the first elements of the wide-field Australian Square Kilometer Array Pathfinder (ASKAP), currently being commissioned. The capabilities of these facilities are described.

Key words: instrumentation: interferometers — methods: observational — telescopes

1. INTRODUCTION

The Australia Telescope National Facility (ATNF) is an open access radio astronomy observatory operated by the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The ATNF consists of the Parkes 64 m radiotelescope, the Australia Telescope Compact Array, and the Mopra 22 m radiotelescope. The Australian Square Kilometer Array Pathfinder (ASKAP), a new wide-field array of thirty-six 12 m antennas, is currently being commissioned and will commence early science in 2015. In addition, under the host country agreement with NASA, some access is provided to the Tidbinbilla 70 m and 34 m antennas. Approximately 5% of the time on these facilities is used for high angular resolution Very Long Baseline Interferometry (VLBI) observations. Observing time on ATNF telescopes is open to astronomers from any country, based on the scientific merits of the proposed research.

The ATNF retains the observing model where the proposers undertake their own observations. Training and observing support is provided, but the proposing teams are required to conduct the observations themselves. This model has been retained for a variety of reasons, primarily as the more that an observer interacts with the data-taking process, the better their understanding of the data quality should be. Being responsible for the observing also allows the observer to modify the observing schedule in real time, and make adjustments to plans based on weather conditions, such as wind-stows, or the Radio Frequency Interference (RFI) environment. Some observing programs are also amenable to changes in real-time based on the observations themselves: a monitoring program might, for example, find a source in a flaring state that can be followed up immediately. The “proposer-as-observer” model is discussed in more

detail in Edwards et al. (2014).

In this paper, each element of the National Facility will be introduced and recent developments highlighted. The Long Baseline Array is described in a separate paper in these proceedings (The Long Baseline Array, by Edwards and Phillips).

2. THE PARKES 64 m

The Parkes radio-telescope has a suite of receivers operating at frequencies between 700 MHz and 26 GHz. It has state-of-the-art digital filterbanks and correlators for pulsar, spectral line and continuum observations. Over the last 4 years Parkes has undergone a number of upgrades and improvements, which have enabled completely remote operations. The upgrades include the installation of a RF switching matrix, the replacement of the manual control panel, improvements to the backup power supplies, and installation of a Telescope Protection System (TPS).

Parkes is a prime-focus telescope, with 2~3 receivers in the focus cabin at any time. The thirteen-beam 20 cm multi-beam receiver (Staveley-Smith et al., 1996) has been the most widely used receiver in the last 17 years, being employed for a number of pulsar and HI surveys. In recent years the concentric 10cm/50cm receiver has also been heavily used, primarily for pulsar observations. The Parkes telescope celebrated its 50th anniversary in 2011, and a chronological review of scientific highlights over that time is given by Edwards (2012).

3. THE AUSTRALIA TELESCOPE COMPACT ARRAY

The Australia Telescope Compact Array (ATCA) is an array of six 22m antennas that operate between 1.1 and 105 GHz. The Compact Array Broadband Backend (CABB) upgrade in 2008 has enabled two 2-GHz bandwidth, dual polarization, channels to be recorded with spectral resolutions ranging from 64 MHz to 0.5 kHz

(Wilson et al., 2011). Subsequent receiver upgrades have resulted in 1.1–3.1 GHz and 4.5–10.5 GHz receivers able to make full use of the 2 GHz CABB bandwidths.

The array is reconfigured every few weeks, cycling through the 17 standard array configurations with maximum baselines between 90 m and 6 km.

High impact results from the compact array include wide-field mosaics of the Large Magellanic Cloud (Kim et al., 1998) and Small Magellanic Cloud (Stanimirovic et al., 1999), a galactic plane HI survey (McClure-Griffiths et al., 2005), and an all-sky 20 GHz survey, AT20G (Murphy et al., 2010). Recent years have seen significant interest in observations of CO in high redshift galaxies (e.g., Emonts et al., 2014).

4. THE MOPRA 22 m

The Mopra radio-telescope is used primarily in the 16–27 GHz, 30–50 GHz and 76–117 GHz bands. The performance in the 7 mm is described by Urquhart et al. (2010) and in the 3 mm band by Ladd et al. (2005) and Foster et al. (2013).

The MOPS spectrometer provides a wideband mode, with four 2.2 GHz bands each with 8192 channels in both polarisations. Up to 16 narrowband “zooms”, can be selected, giving 33 kHz wide channels.

Both position switched observation and on-the-fly mapping modes are available, with the mapping mode employed for a survey of the galactic plane in the 15 mm band, HOPS (Walsh et al., 2011), a 3 mm survey of the central molecular zone, CMZ (Jones et al., 2012), and a survey of dense molecular cores, MALT-90 (Jackson et al., 2013), amongst others.

Since October 2012 Mopra has been operated under an externally funded model. The National Astronomical Observatory of Japan (NAOJ) and a consortium led by the University of New South Wales (UNSW) are funding a share of the annual costs in return for their own observing time, with ~5 weeks available each winter for open access under the standard proposal process.

A severe bushfire in January, 2013 burned a large region near Coonabarabran including the Mopra and Siding Spring Observatories. Fortunately, the Mopra telescope and the key data-taking equipment were spared by the fire, but mains power was cut and the on-site building suffered significant damage. The telescope was returned to operations in May 2013.

CSIRO announced in May 2014 that it would cease funding the Mopra telescope. Discussions are currently underway with parties interested in extending the life of the telescope beyond the conclusion of the existing agreements with NAOJ and UNSW in October 2015.

5. ASKAP

The newest element of the ATNF is the Australia Square Kilometre Array Pathfinder. ASKAP is a 36 antenna, wide-field array capable of observing with a 300 MHz bandwidth in the range 700 MHz and 1.8 GHz. ASKAP is being outfitted with Phased Array Feeds (PAFs), each covering 30 square degrees of sky, making it a superb

survey instrument. The antennas have altitude and azimuth axes, and also have a novel third axis enabling the dish and feed support legs to be rotated. This enables the PAF to have a fixed orientation on the sky, resulting in higher fidelity imaging. The array is currently being commissioned, providing experience in the beam forming and calibration of the novel feeds (Hotan et al., 2014). In the first years of operation it is expected 75% of the observing time will be dedicated to a number of large survey projects. The range of science possible with ASKAP is described in Johnston et al. (2007, 2008).

6. TIDBINBILLA

The Canberra Deep Space Communications Complex (CDSCC) is operated by CSIRO under contract for NASA. Under the host country agreement, ~5% of the time is made available to ATNF users. Single dish observing, primarily with the 70 m telescope, is carried out in service mode. The 70 m and 34 m telescopes also participate in VLBI observations as part of the Long Baseline Array on occasions.

7. ARCHIVAL DATA

Observers have proprietary rights to their data for a period of 18 months from the date of the observation. After this period the data is available to any interested party. ATCA data, Mopra data from 2006 (after the installation of MOPS), and data for some Parkes projects are available from the Australia Telescope Online Archive (ATOA) — <http://atoa.atnf.csiro.au/>. Additionally, data cubes from the Mopra MALT-90 and CMZ projects are available through ATOA. Data from an increasing number of Parkes pulsar observations are being made available through the CSIRO Data Access Portal — <http://data.csiro.au/>.

8. THE SCIENCE OPERATIONS CENTRE

The Science Operations Centre (SOC) was established at ATNF Headquarters in Sydney in 2012, with a view to centralising the observing support and expertise for the existing telescopes and ASKAP. It also enables visiting astronomers to more easily interact with the ATNF Astrophysics group, which is located in Sydney. The SOC is now the default location for Parkes observing and (from October 2014) the ATCA. First-time observers must observe from the SOC; suitably qualified observers may observe from other locations, but must return annually to the SOC to re-qualify. Video-links between the SOC and the observatories have been installed to allow consultation with Observatory staff.

9. SUMMARY

The ATNF provides open-skies access to radio telescopes covering a wide range of frequencies and angular resolutions. A call for proposals is made twice each year, with proposal deadlines in mid-June (for the October to March semester) and mid-December (for the April to September semester). Observations

at the shorter wavelengths are best made in the April semester, corresponding to the Austral winter. Further information is available from the ATNF website — <http://www.atnf.csiro.au/>.

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ACKNOWLEDGMENTS

The Parkes and Mopra radio telescopes are part of the Australia Telescope National Facility which is funded by the Commonwealth of Australia for operation as a National Facility managed by CSIRO. The Wajarri Yamatji people are acknowledged as the traditional owners of the ASKAP Observatory site.

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