



## Call for expressions of interest to operate or fund the Mopra Telescope

*18 November, 2011*

### Summary

CSIRO is seeking an alternative operator or new funding sources for the Mopra Telescope from October 2012, when current Mopra funding will be redirected to ASKAP operations. Interested parties are invited to respond.

This document describes the capabilities of Mopra and outlines the current operating costs. Several possible operating models are presented. CSIRO will assist with the design of alternative operating models, including models that trade cost against availability and functionality. CSIRO anticipates being able to provide support for the telescope from Narrabri and Sydney.

CSIRO wishes to retain a level of access to Mopra for the Long Baseline Array (LBA) as part of any new operating arrangement.

### Capabilities

The 22-m diameter Mopra radio telescope is located near the town of Coonabarabran in New South Wales. It is currently operated as part of the Australia Telescope National Facility, which also includes the Australia Telescope Compact Array and the Parkes radio telescope. Following several upgrades in recent years, the Mopra Telescope has become a world-class facility and is the only single-dish telescope in the Southern Hemisphere operating at wavelengths of 3 and 7 mm. Mopra is an excellent survey instrument that can simultaneously image 16 molecular lines at high spectral resolution and sensitivity with a bandwidth up to 8 GHz. The telescope is operated fully remotely and requires little maintenance, making it extremely cost-effective. CSIRO, with support from the University of New South Wales, has contributed significant effort over the past decade to achieve high levels of stability and reliability in the operation of Mopra. The benefit of these achievements is reflected in its scientific productivity: 35 papers published in 2008-2010 with a mean citation rate of 10.

Mopra's strength lies primarily in its ability to map emission from molecular-line transitions, which reveal a wealth of information about molecular clouds and star formation. The Mopra telescope is largely used for Galactic studies of molecular clouds and star formation, with some additional studies of the Magellanic Clouds and other galaxies. Several large Galactic surveys are currently underway.

Mopra's ability to map large areas of the sky efficiently is a substantial contribution to the wider community; especially as ALMA science observations have recently commenced. Because of its superlative sensitivity and angular resolution, the multi-billion dollar ALMA will soon become the world's premier instrument for studies of star-formation. For its optimal use, however, single dish surveys must pave the way to identify the targets for follow up study and Mopra will continue to have a key role with such surveys.

Mopra is supported by CSIRO staff based in Narrabri and Sydney (Marsfield). The current level of funding allows Mopra to be operated with a “National Facility” level of support, including time allocation on a competitive basis, and support for new users. The telescope is typically scheduled from February to October. Most 3-mm observing is carried out between May and October. 12-mm observations can be undertaken at any time. The telescope usually has less than 5% unscheduled downtime as a result of equipment failure, and time lost due to weather of ~15%.

### Cost of operating Mopra

The present cost of operating Mopra is approximately A\$500,000 annually. This does not include expenditure at Narrabri and Sydney that enables observing with Mopra but which would be required (e.g., for the ATCA) even if Mopra were not operated. I.e., this represents the incremental costs of operating Mopra above the costs of operating the other facilities. The breakdown of costs is shown in Table 1.

**Table 1: Current costs of operating Mopra**

	A\$
Science operations labour	150,000
Engineering operations labour	150,000
Electricity and diesel	60,000
Network charges and maintenance, telephone	68,000
Property maintenance	10,000
Telescope maintenance, supplies and travel	40,000
<b>Total</b>	<b>478,000</b>

The labour components include:

- 0.7 full-time-equivalent (FTE) scientific support, including user support and training, software maintenance, computing infrastructure maintenance (approximately \$150,000 including overheads). The current model provides most support in working hours, and limited support after hours. This cost could be reduced considerably if most or all users are supported by another organisation;
- 0.7 FTE engineering support from numerous individuals, principally based in Narrabri (approximately \$150,000). This cost has been calculated based on actual visits to Mopra by Narrabri-based staff. Most of this support is provided during weekday visits to the observatory, and in preparation for these visits. We anticipate any operating organisation would find it cost effective to continue to make use of CSIRO resources for this maintenance although other arrangements can be considered.

The quoted cost excludes:

- Accommodation subsidies to visiting observers at Narrabri and Sydney; real costs would be charged to users if the telescope ceases to be part of the National Facility;
- Depreciation of approximately \$200,000 per year;
- Upgrades, refurbishments, major repairs.

The high level of reliability of the Mopra Observatory in recent years is due to significant engineering work undertaken to support remote operations, which commenced in August 2006, and capital investment in Engineering Changes between 1990 and 2006. The Mopra site is unstaffed.

Maintenance of this increased reliability over time will require continued engineering effort (software and hardware) to improve, upgrade or ensure a standard level of configuration with the Compact Array where possible. However, barring any need for major repairs, the present level of support is expected to be sufficient for several years.

### **Possible future operating models**

CSIRO presently operates the Mopra telescope as part of the Australia Telescope National Facility. To maintain the science capability of the telescope, CSIRO invites parties to submit proposals for the use of Mopra. Possible models include:

1. **Funding arrangement:** Another organisation or organisations provide(s) funding for the telescope to remain part of the National Facility, operated by CSIRO. This option can be considered if there is reasonable continuity of funding from a small number of partners. Time allocation and all normal operational responsibilities would remain with CSIRO.
2. **Transference and Sub-Contracting arrangement:** Another organisation takes responsibility for the operation of the telescope, including time allocation. CSIRO could provide support for the telescope on a cost reimbursement basis. Under this option CSIRO retains access for a small component of the telescope's time to remain in the Australia Telescope National Facility. The cost of repairs and risk of interruption to observations in the event of any equipment failure or external influence are borne by the operating organisation. The operating organisation takes responsibility for raising all necessary operating, repair, and upgrade funds for the scientific infrastructure on site, and contracting with CSIRO for the provision of desired services.
3. **Transference of Control and Possibly Ownership:** Another organisation takes over control and ownership of the telescope, and possibly the site. CSIRO could provide support for the telescope on a cost reimbursement basis, through a contract. The normal risks and liabilities of ownership would rest with the owning organisation. CSIRO would seek to purchase a fraction of time for Long Baseline Array use.
4. **Contracting to CSIRO:** One or more organisations provide funding to CSIRO for a fixed period of time to operate Mopra on their behalf. In this case most of the available observing time is available to the funding organisations. Mopra largely ceases to be part of the National Facility, although a minority of the time could be made available to ATNF users in recognition of the capital investment. This option can only be considered for a small number of organisations that have a track record of achieving high science outcomes. CSIRO would expect that each of the contributing organisations would be able to contribute of order \$200k. The costs would include a management fee.

These models are not intended to be exhaustive and other financially viable models can be considered.

If CSIRO continues to own the Mopra telescope and instrumentation and cover the depreciation, then it would seek to retain a fraction of observing time for National Facility access, including the Long Baseline Array. Currently the LBA is scheduled for about three weeks per year.

## **Expressions of interest**

Expressions of interest to operate or fund Mopra should be submitted by 16 January 2012. Following this date, CSIRO will begin negotiating with potential partners that present viable cases. Expressions of interest from individual organisations or consortia should include prospects for funding, whether a particular model is preferred at this stage, and any desire to become part of and/or lead a collaboration.

Preliminary enquiries are encouraged. For further information, or to submit an expression of interest, please contact Douglas Bock ([douglas.bock@csiro.au](mailto:douglas.bock@csiro.au); +61 2 9372 4276).

All expressions of interest will be held in confidence. However, CSIRO will also assist interested parties in the formation of collaborations to operate Mopra.