# AuScope VLBI Project and Hobart 26-m Antenna

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**Abstract**

This is a report on the activities carried out at the three AuScope VLBI observatories and the Hobart 26-m antenna. In 2011 the AuScope 12-m antenna at Hobart (Hb) completed its first full year of operations while the Katherine (Ke) and Yarragadee (Yg) antennas were commissioned and commenced operation. The Hobart 26-m antenna (Ho) continued to make a contribution to IVS, providing overlap with the Hb time series. The Hobart 12-m also participated in the 15-day CONT11 campaign in September. In total the AuScope antennas and the Hobart 26-m observed for 171 antenna days in 2011.

## 1. Introduction

In 2006 the National Collaborative Research Infrastructure Strategy (NCRIS) initiated program 5.13, "Structure and Evolution of the Australian Continent", which is funded by the Australian Federal Government's Department of Innovation, Industry, Science and Research (DIISR) and managed by AuScope Ltd. (www.auscope.org.au). A major component of this project was the establishment of a national geospatial framework to provide an integrated spatial positioning system spanning the whole continent. Total federal funding for this undertaking is AUD$15.8M, together with AUD$21M from universities, state governments and Geoscience Australia. The infrastructure that was funded to achieve this improvement to the geospatial framework included:

- three 12-meter radio telescopes and a software correlator
- approximately 100 GNSS receivers
- an upgrade of existing SLR facilities
- an absolute gravimeter and three tidal gravimeters
- improved computing facilities

## 2. VLBI Facilities

As part of this effort, the University of Tasmania (UTAS) has constructed three new radio telescopes, located near Hobart (Tasmania), Yarragadee (Western Australia), and Katherine (Northern Territory). UTAS is responsible for construction and operation of these new VLBI sites (Figure 1). The AuScope telescopes closely follow the International VLBI Service VLBI2010 specification for the next generation of telescopes for geodesy (Petrachenko et al., 2009) or provide an upgrade path to meet the specification where it is not currently possible to do so.

The new Hobart telescope (Hb) is co-located with the existing 26-m telescope (Ho) to preserve the more than 20 year VLBI time series at the site. Midway between the 26-m and 12-m telescopes is the HOB2 GNSS installation which has been a core site of the International GNSS Service (IGS) since its conception. A hut capable of housing a mobile gravimeter is also co-located on the site. The Yarragadee telescope (Yg) provides a far western point on the continent and is co-located with multiple existing geodetic techniques including SLR, GNSS, DORIS and gravity. The Katherine

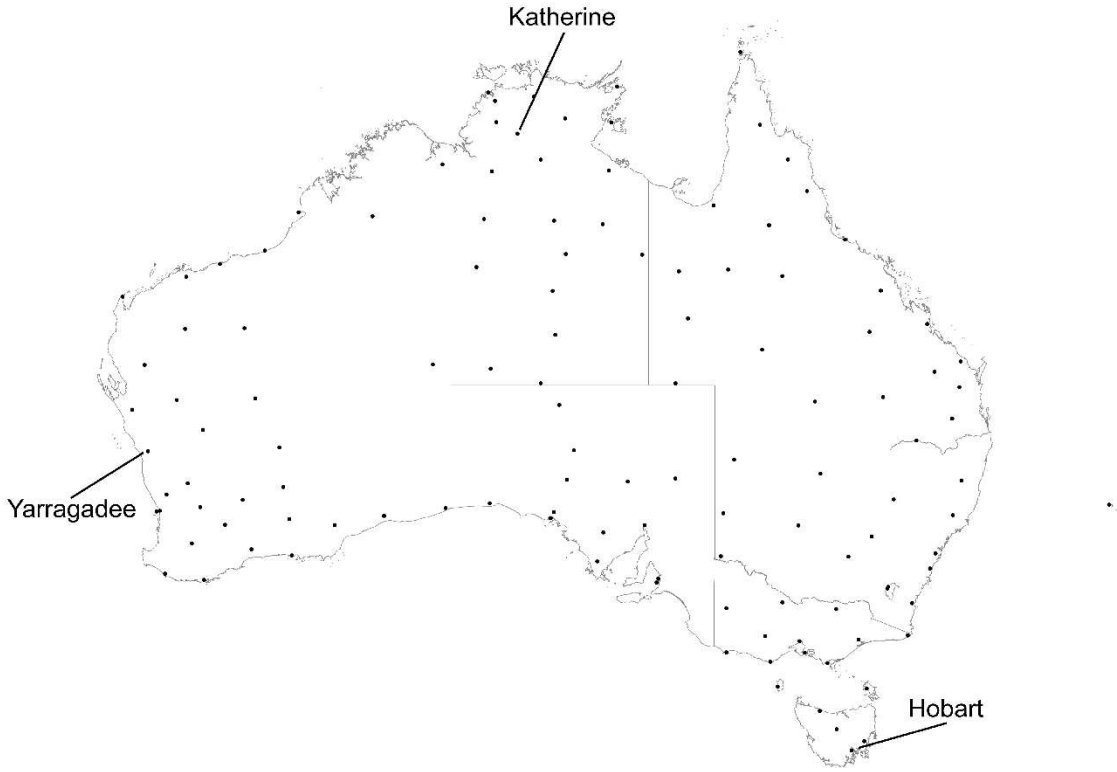


Figure 1. The geographical distribution of VLBI and GNSS infrastructure for AuScope. From west to east, the new VLBI stations are at Yarragadee, Katherine, and Hobart. An additional ∼100 GNSS receivers will be distributed across the continent.

site (Ke) is new and provides a central longitude, northern site. The telescope at Katherine is co-located with a new GNSS site that forms part of the AuScope GNSS network.

Each AuScope VLBI observatory is equipped with a 12.1-m diameter main reflector designed and constructed by COBHAM Satcom, Patriot Products division. The telescope specifications include: 0.3 mm of surface precision (RMS), fast slewing rates (5 deg/s in azimuth and 1.25 deg/s in elevation), and acceleration (1.3 deg/s/s). All three sites are equipped with dual polarization S- and X-band feeds from COBHAM with room temperature receivers, developed at UTAS by Prof. Peter McCulloch. The receiver systems cover 2.2 to 2.4 GHz at S-band and 8.1 to 9.1 GHz at X-band. System Equivalent Flux Densities (SEFDs) are 3500 Jy in both bands. Data digitization and formatting is managed by the Digital Base Band Converter (DBBC) system from HAT-Lab, and data are recorded using the Conduant Mark 5B+ system. Each site is equipped with VCH-1005A Hydrogen maser time and frequency standards from Vremya-CH.

All three observatories were designed and constructed to be remotely controlled and monitored to keep operating costs at a minimum. Operation of the AuScope VLBI array is being carried out from a dedicated operations room on the Sandy Bay campus of the University of Tasmania.

## 3. Staff

Staff at UTAS consist of academics, Prof. John Dickey (director), Dr. Simon Ellingsen, and Prof. Peter McCulloch. Dr. Jim Lovell is Project Manager for the AuScope VLBI project. Dr. Jamie McCallum and Dr. Stas Shabala are Australian Research Council Super-Science Fellows who are carrying out research aimed at improving geodetic VLBI solutions in the southern hemisphere. Mr. Brett Reid is the Observatory Manager whose position is funded by the university. In addition we have an electronics technical officer, Mr. Eric Baynes. For operation of the observatories during geodetic observations we rely heavily on support from astronomy PhD and post graduate students. Logistical and maintenance support at Katherine is provided by Mr. Martin Ephgrave and at Yarragadee by Mr. Vince Noyes and team at the MOBLAS5 SLR station.

## 4. AuScope VLBI Project Status

Construction of the first AuScope telescope at Hobart was completed in 2009 and officially opened at the IVS General Meeting on February 9, 2010. Following a period of commissioning, testing and debugging, the Hobart telescope made its first successful IVS observation in October 2010. Construction and commissioning at the other two sites continued in parallel. Yarragadee made its first successful IVS observation in May 2011, and all three telescopes participated in an IVS observation for the first time on June 16, 2011.

At present, the AuScope VLBI facility has sufficient operational funds for $\sim$70 observing days per year, usually consisting of two AuScope telescopes observing as part of the IVS network. The Hobart 26-m antenna will continue to participate in IVS observations at the level of one session per month to provide continuity in the Hobart time series.

## 5. Geodetic VLBI Observations

In 2011 the AuScope and Hobart 26-m antennas participated in 102 IVS sessions for a total of 171 antenna days of observing. This included the Hobart 12-m participating in the 15-day

CONT11 campaign. A summary of the observations is presented in Table 1

Table 1. AuScope and Hobart 26-m antenna participation (number of days) in IVS sessions in 2011.

| Session | Antenna | | | |
|---|---|---|---|---|
| | Ho | Hb | Ke | Yg |
| AUSTRAL | | 2 | 2 | 2 |
| CONT11 | | 15 | | |
| CRDS | | 5 | 4 | 3 |
| CRF | | 3 | | |
| OHIG | 1 | 2 | | |
| R1 | 11 | 27 | 9 | 8 |
| R4 | 12 | 29 | 11 | 11 |
| RD | | 2 | 1 | 1 |
| RDV | | 1 | | |
| T2 | 3 | 4 | 1 | 1 |
| Total | 27 | 90 | 28 | 26 |

## 6. References

Petrachenko, B. et al., 2009, "Design Aspects of the VLBI2010 System. Progress Report of the IVS VLBI2010 Committee.". NASA/TM-2009-214180, June 2009.