The Southern Hemisphere VLBI Experiment program, SHEVE

D. L. JAUNCEY, J. E. REYNOLDS, A. K. TZIOUMIS, R. H. FERRIS, R. P. NORRIS, M. W. SINCLAIR, V. MIGENES, R. G. GOUGH and R. M. WARK
Australia Telescope National Facility, CSIRO

R. A. PRESTON, D. L. MEIER, D. W. MURPHY, D. L. JONES, D. W. HOARD, MARY E. ST JOHN and L. SKJERVE
Jet Propulsion Laboratory

E. A. KING, P. M. MCCULLOCH, J. E. J. LOVELL and P. A. HAMILTON
University of Tasmania

M. E. COSTA and D. G. BLAIR
University of Western Australia

P. EDWARDS and R. W. CLAY
University of Adelaide

D. CAMPBELL-WILSON, S. W. AMY and W. B. MCADAM
University of Sydney

G. L. WHITE and P. A. JONES
University of Western Sydney, Nepean

and

G. D. NICOLSON
Hartebeesthoek Radio Astronomy Observatory

Abstract. The Southern Hemisphere VLBI Experiment (SHEVE) program is aimed at producing high-resolution images of southern radio sources. The radio telescopes of the present SHEVE array are described below and some recent results presented.

Key words: VLBI, Array

1. Introduction

Australia, as the continent with the major radio astronomy facilities in the Southern Hemisphere, plays an important role in very high angular resolution radio imaging. VLBI in the Southern Hemisphere is undertaken through a collaborative program involving radio telescopes at eight sites in Australia and one in South Africa, with many international connections into the US and the Asia-Pacific region. This program is known as the Southern Hemisphere VLBI Experiment, or SHEVE, and has grown out of the earlier 1982 observations (see Preston et al. 1989). More recently, a considerable effort has been undertaken to enhance both the sensitivity and u-v coverage (Jauncey 1991; Preston et al. 1993).

2. The SHEVE Telescopes

Co-operative observing sessions of one to two weeks duration are usually scheduled three times a year through the ATNF Time Assignment Committee. Figure 1 shows a map indicating the location of the SHEVE telescopes. Participating radio telescopes include the AT LBA sites at Narrabri, Mopra and Parkes, together with

J.G. Robertson and W.J. Tango (eds.), Very High Angular Resolution Imaging, 131–134.

the NASA Deep Space Network telescopes at Tidbinbilla, the Mt Pleasant Observatory near Hobart, the ESA tracking antenna near Perth and the Hartebeesthoek Radio Astronomy Observatory in South Africa. The Molonglo Observatory Synthesis Telescope, MOST, has been added for observations at 0.843 GHz and the Alice Springs Landsat antenna has also been used occasionally with the SHEVE array. Recently, at 5 GHz the 27.5 m AOTC communications antenna near Perth has participated in the SHEVE program.

Observing frequencies supported by the SHEVE array include 0.843, 1.7, 2.3, 4.8 and 8.4 GHz, although not all telescopes support all frequencies. MkII recording terminals are located at all sites and MkIII terminals at Parkes, Tidbinbilla, Hobart and HartRAO. The MkII data are correlated at the JPL/Caltech Block II correlator and the MkIII data at the Washington correlator. By 1994, S-2 recorders will be available with a domestic S-2 correlator.

3. Some Recent Results

Recent results include multi-epoch images of the nucleus of Centaurus A (NGC 5128, PKS 1322-427). At a distance of 4 Mpc (1 mas = 0.019 pc) Centaurus A is the nearest active galaxy to the Milky Way and the nucleus has been imaged with the SHEVE array at 2.3 and 8.4 GHz at several epochs (Meier *et al.* 1989). No structural changes have been seen at 2.3 GHz over an eight-year period although at 8.4 GHz significant changes were seen in both flux density and core structure (Meier *et al.* 1993). The change in elongation of the nuclear jet over a nine-month period in 1991 indicates that it is expanding at a speed of 4.0 ± 0.8 mas/yr, v=0.26 c, along the 51° position angle of the large-scale radio jet.

The unusually strong Einstein ring radio source PKS 1830-211 (Jauncey *et al.* 1991) has also been the target of multi-epoch SHEVE imaging observations (Jauncey *et al.* 1993) as well as with a northern global VLBI array (Jones *et al.* 1993). This source has varied dramatically in intensity at 8.4 GHz and hence it is likely that an accurate estimate of the time delay in the ray paths between the two lensed images will be measurable in the future.

At 2.3 GHz images of a number of strong southern radio galaxies and quasars have been made (Murphy *et al.* 1993), and a VLBI survey is under way of a sample of Parkes sources with spectral peaks in the range 0.1 to 2 GHz. Many of these sources are doubles with high brightness temperature components separated by up to $0.5''$ (King *et al.* 1993). The discovery of the Einstein ring radio source PKS 1830-211, which is in this sample, and the wide $6''$ separation found for the two high brightness-temperature components in the unusual source MSH 04-71 (Reynolds *et al.* 1993) raises the question: how many of such sources are gravitational lenses?

References

Jauncey, D.L., 1991, 'VLBI in Australia - A Review', *Aust. J. Phys.*, **44**, 785-803.

Jauncey, D.L., *et al.* 1991, 'An unusually strong Einstein ring in the radio source PKS 1830-211', *Nature*, **352**, 132-134.

Jauncey, D.L., and the SHEVE Team, 1993, 'Southern Hemisphere Observations of PKS 1830-211', Proc. Symposium on Sub-Arcsecond Radio Astronomy, Manchester, July 1992, in press.

Jones, D.L., and the SHEVE Team, 1993, 'Northern Hemisphere VLBI observations of PKS 1830-211', Proc. Symposium on Sub-Arcsecond Radio Astronomy, Manchester, July 1992, in press.

King, E.A., and the SHEVE Team, 1993, 'A VLBI survey of Southern Hemisphere peaked spectrum sources', Proc. Symposium on Sub-Arcsecond Radio Astronomy, Manchester, July 1992, in press.

Meier, D.L., *et al.* 1989, 'The high resolution structure of the Centaurus A nucleus at 2.3 and 8.4 GHz.', *Astron. J.*, 98, 27-35.

Meier, D.L., and the SHEVE Team, 1993, 'Multi-epoch 8.4 GHz VLBI observations of the nucleus of Centaurus A', Proc. Symposium on Sub-Arcsecond Radio Astronomy, Manchester, July 1992, in press.

Murphy, D.W., and the SHEVE Team, 1993, '2.3 GHz VLBI images of Southern Hemisphere radio galaxies and quasars', Proc. Symposium on Sub-Arcsecond Radio Astronomy, Manchester, July 1992, in press.

Preston, R.A. *et al.* 1989, The Southern Hemisphere VLBI Experiment, *Astron. J.*, 98, 1-26.

Preston, R.A., and the SHEVE Team, 1993, 'The Southern Hemisphere VLBI Experiment (SHEVE)', Proc. Symposium on Sub-Arcsecond Radio Astronomy, Manchester, July 1992, in press.

Reynolds, J.E., and the SHEVE Team, 1993, 'The unusual radiosource MSH 04-71', Proc. Symposium on Sub-Arcsecond Radio Astronomy, Manchester, July 1992, in press.

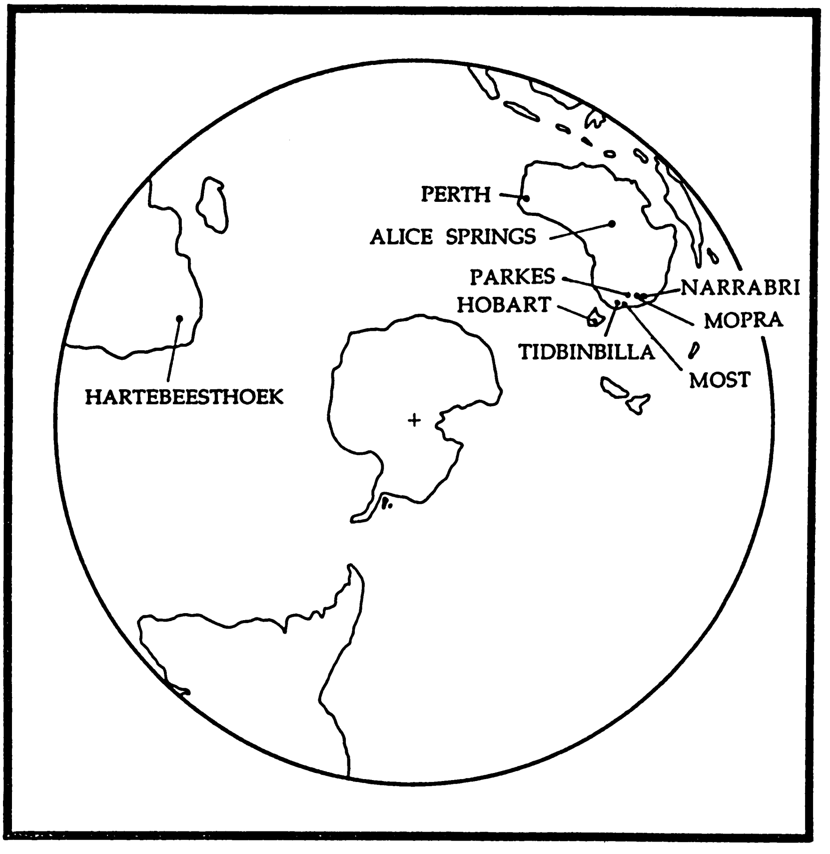

Fig. 1. The location of the telescopes of the SHEVE array.