THE SOUTHERN HEMISPHERE VLBI EXPERIMENT (SHEVE)+

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The Southern Hemisphere VLBI Experiment (or SHEVE) was a joint US-Australian-South African venture with both astronomy and geodesy goals. The principle astronomy goal was to make models or maps of the following sources: at 2.3 GHz (with six antennas and 9 usable baselines) -- Centaurus A (the nearest active galaxy), Circinus X-1 (a flaring binary), the VELA pulsar, and 26 other active galactic nuclei and quasars; at 8.4 GHz (only one baseline) -- Centaurus A and the galactic center.

The SHEVE array consisted of six antennas -- five in Australia and one in South Africa. JPL's 64m Deep Space Network antenna at Tidbinbilla, the CSIRO 64m antenna at Parkes, and one of the 14m antennas at Fleurs form an equilateral triangle of about 250 km on a side. About 1000 km away from the triangle is the 14m antenna at Hobart and about 2000 km away is the 9m Landsat antenna at Alice Springs. The 26m antenna at Hartebeesthoek, South Africa provides an 8000 km baseline.

Of the 30 sources observed, only three will be discussed. Centaurus A is a dust-lane and shell galaxy only 5 Mpc distant. Early radio maps showed very extended (10 degree) north-south double structure plus a smaller (8 arc minute) double at a position angle of 50 degrees. Recent VLA maps show a northeast jet emanating from the nucleus and aligned with the inner double. Earlier one baseline VLBI observations (Preston et al. 1983) showed an elongated central component about 50 milliarc-seconds long (∿1 pc) consistent with the VLA jet position angle. The

+ Discussion on page 427

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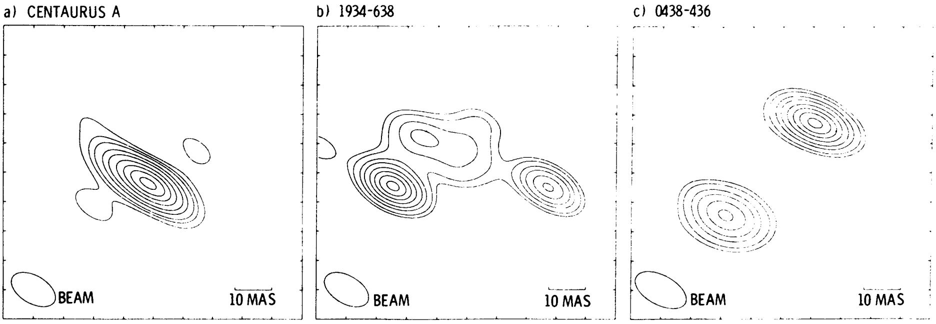

Figure 1. Hybrid Maps

SHEVE data pin down this angle much more precisely to about 51° and indicate the core is slightly extended in the northeast direction.

A hybrid map of Centaurus A generated from the SHEVE data is shown in Figure 1a. Model fitting was also performed on the Centaurus A data. It is less reliable than hybrid mapping, but tends to bring out more features. All components were assumed to have Gaussian shapes and to lie at a position angle of 50° on the northeast side of the nucleus. The data were fitted with four components: the central source splits into two -- an elongated 12 milliarcsecond core at position angle 51° and a blob about 40 milliarcseconds away. There is also a very narrow component at position angle 49° whose distance from the center is uncertain and a component about 0".25 away which may be observable with the VLA.

Parkes 1934-638 is also a dust-lane galaxy, but at $z = 0.138$. Data from a 1970 one-baseline VLBI experiment at 2.3 GHz were modeled with a 41.9±0.2 milliarcsecond (or 87 pc) double plus another weaker component (Gubbay et al. 1971). The 1982 SHEVE map (Figure 1b) at 2.3 GHz also shows a double with almost exactly the same separation (42.0±0.06 milliarcseconds) yielding a limit of 0.06c±0.2c on the expansion velocity. We also find a third component between the two, but offset from their line of centers. The 1 GHz spectral peak of 1934-638 is similar to that of other compact double sources (Phillips and Mutel 1981).

The final object is Parkes 0438-436. At a redshift of 2.863 it is the most radio-luminous quasar known ($L_{Radio} \sim 10^{46}$ erg s^{-1}). Several other high redshift quasars appear generally unresolved with VLBI. The SHEVE map (Figure 1c) reveals an equal double separated by about 35 mas (about 250 pc). The southeast component is resolved in our map while the northwest one is unresolved.

In summary, these three sources show some similarities and some differences among their optical and radio properties. Centaurus A and 1934-638 are both dust-lane galaxies, but display quite different radio structure, a jet and a compact double. 1934-638 and 0438-436 have similar radio structure, but one is a galaxy and the other a quasar. Theories of compact radio sources which employ a common central energy mechanism will have to account for such variations of form.

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