A SEARCH FOR VERY COMPACT STRUCTURE IN 17 OH MASERS

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The apparent spot sizes of OH masers appear to be significantly broadened when seen through the inner galaxy or large extents of the galactic disk (Burke 1968). Bowers et al (1980) found evidence of small-scale structure ($\lesssim$50 mas) in OH sources at distances of less than 5 kpc but this was characteristically absent in very distant sources ($\gtrsim$8kpc) at galactic longitudes $1 \lesssim 40°$. This result is typically explained in terms of interstellar scattering (ISS) by intervening diffuse HII regions.

Determinations of the galactic distribution of ISS have used both pulsars (Cordes 1983) and compact extragalactic radio sources (Dennison et al 1984) as probes of the interstellar medium. Surveys of OH maser spot sizes can provide useful complementary information on the low latitude galactic distribution of scattering material. In this context the intrinsic size of OH maser components is also of interest. Interferometric observations of interstellar hydroxyl masers in W3(OH) by Reid et al (1980) indicate characteristic sizes of 2×10^{14} cm with 25% of the components in the masing region exhibiting even more compact structure.

We present here the results of a pilot VLBI search for very compact structure in a sample of 17 strong 1665 MHz OH masers selected from the catalogues of Caswell and Haynes (1983a and 1983b). This was a single-baseline experiment involving Medicina (Bologna) and Hartebeesthoek (Johannesburg). The sources cover the range of galactic longitude from 355° to 50°.

The observations were carried out during three 8 hour sessions during 1986 April 17-19. All observations were made with left circular polarization and a bandwidth of 62.5 kHz. The data were taken on the MKII video tape recording system. Each source was observed for four 15 min scans distributed in hour angle. The long north-south interferometer geometry yielded limited u-v coverage about a projected baseline length of 40 Mλ with an interferometer fringe spacing of 5 mas.

M. J. Reid and J. M. Moran (eds.), The Impact of VLBI on Astrophysics and Geophysics, 255–256.

Standard techniques were used in data reduction (Reid et al 1980). The cross-power spectra were coherently averaged for 3 min yielding 3 Jy rms noise in cross-power amplitude. The spectra were Hanning weighted and have a resolution of 0.088 kms^{-1}.

Positive detections were obtained for three of the 17 sources. The apparent angular size of the most compact feature in each spectrum was calculated from the normalised visibility based on a circularly symmetric Gaussian brightness distribution model. Intrinsic spot sizes, for both the near and far kinematic distances, and the apparent brightness temperatures of the detected components are indicated in Table I. For the three sources where compact components were detected it is almost certain that the distance ambiguity is resolved (Downes et al 1980) but both distances are included for completeness. Less likely values are included in parentheses.

TABLE I. LIST OF COMPACT COMPONENTS DETECTED

Source name	Velocity (kms^{-1})	Flux (Jy)	Angular size (FWHM / mas)	Linear size (10^{14} cm)	T_b (10^{13}K)
OH34.26+0.15	55.9	39.5	1.4 ± 0.6	0.75 (2.2)	1.0
OH35.20-1.73	42.4	30.9	0.8 ± 0.8	0.30 (1.4)	2.5
OH45.47+0.13	59.3	26.4	2.5 ± 0.4	(1.5) 3.0	0.21

It is noted that all the detected sources are at galactic longitudes $l \geq 35°$. Two of the sources, OH 34.26+0.15 and OH 35.20-1.73, are at probable distances of $\lesssim 4$ kpc. Clearly this is not statistically significant but the result is consistent with previous determinations of the interstellar broadening of compact low galactic latitude radio sources (Dennison et al 1984). The data also possibly indicate the existence of maser spots with intrinsic sizes somewhat smaller than the commonly accepted value of 2×10^{14} cm for 1665 MHz OH maser components. This in turn implies larger apparent brightness temperatures than previously reported. As a pilot survey the experiment was successful in the detection of very compact structure in interstellar OH masers.

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