THE GROUND STATE HYDROXYL MASERS ASSOCIATED WITH OH 340.78−0.10

Ralph A. Gaume
Department of Astronomy
University of Michigan
Ann Arbor, MI 48109

The dynamics of the molecular envelopes surrounding ultracompact H II regions has been the subject of much debate. Since the envelopes often exhibit molecular line emission, line observations have been the primary method of probing these circumstellar shells. The existence of expansive motions in the molecular clouds surrounding massive newly formed stars has been firmly established. Proper motion studies of galactic water masers indicate general expansion, whereas high resolution CO studies often show collimated bipolar outflows centered on continuum H II regions. Maps of the OH maser emission, often associated with these regions, show the masers scattered, apparently randomly, in both position and velocity across an area a few arcseconds in size. Typical velocity ranges for the associated OH maser emission are on the order of 10 km s^{-1} . A number of models of the dynamical and physical conditions of the masing envelope have been developed to explain the properties of specific regions, e.g., collapsing remnant accretion envelopes, rotating disks or tori of neutral material, and expanding shells of shocked material. There is evidence from comparing the velocities of the OH masers to that of recombination lines associated with the underlying H II regions that in most sources the OH masers are formed in material still accreting toward the central object (Garay et al., 1985) (however see Welch and Marr, 1986). Mirabel et al., 1986, have reported the detection of (thermal and subthermal) high velocity OH outflow in several regions of star formation, demonstrating that OH molecules, at least in some instances, are also involved in collimated flows from central stellar objects.

OH 340.78−0.10 is a maser source whose main-line ground state spectrum covers a moderately large velocity range, and tends to resemble the double-peaked spectrum of OH/IR stellar sources (see Figure 1). We have mapped the OH masers and associated continuum emission toward OH 340.78−0.10 with the VLA of the NRAO. The observations were conducted 11 September 1986 in the B configuration. We observed the four ground state OH maser transitions in a 32 channel spectral line mode, with a velocity resolution of $\approx$ 1.1 km s^{-1} . Typical 1σ relative positional uncertainties for masers features of a given transition are on the order of 1.5 by 0.3″ (p.a. 0°), with larger uncertainties for the weaker features. The continuum observations were made at $\lambda = 6$ cm. The continuum source is unresolved by the 4.6″ by 0.9″ beam. The uncertainty in the position of the continuum source with respect to the position of the OH masers is $\approx$ 1.0 by 0.5″ (p.a. 0°).

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The spatial distribution of the OH maser emission is unusual for a region of star formation. Even though the emission covers a broad velocity range, all the features appear to be spatially coincident (within positional errors). Of the regions that have been mapped with high resolution techniques, only W49 N - G, where OH masers in a 64 km s^{-1} velocity range are found within a 0.5″ area (Gaume and Mutel, 1987), displays a similar (though larger) velocity dispersion for spatially coincident maser features. These sources apparently do not fit any of the standard dynamical models that have been proposed for other regions of OH maser emission. Instead, we suggest the masers in these regions are tracing dense OH clumps driven by mass outflow from a central star. The masers could be collisionally pumped as the individual OH clumps are decelerated via collisions with the surrounding molecular cloud. Alternatively, the masers could trace regions of unusually favorable velocity coherence in a region of general OH outflow, such as those OH outflows detected by Mirabel et al. (1986).

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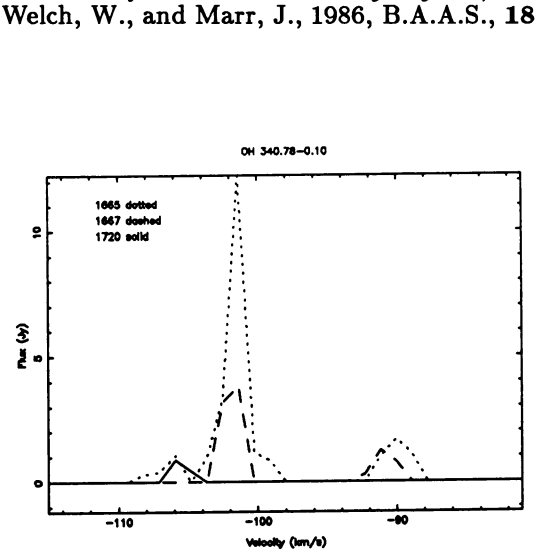

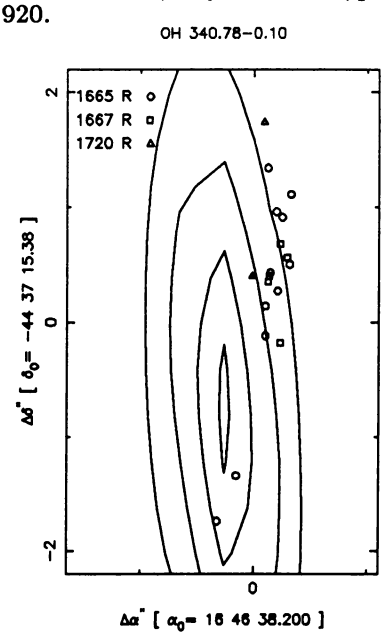

Figure 1. (left) Summed VLA spectra of the RCP OH maser emission associated with OH 340.78−0.10.
Figure 2. (right) Distribution of the OH 340.78−0.10 ground state OH maser emission superposed on 5 GHz continuum contours. Contour levels are 25, 50, 75, and 95% of the peak emission (8 mJy). The data's relative and absolute positional uncertainty is discussed in the text.

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