OH-IR SOURCES AND THE GALACTIC CENTRE DISTANCE

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ABSTRACT The phase-lag technique of estimating distance to OH-IR sources is briefly described. Preliminary results are presented from a study of nine OH-IR sources in the galactic centre direction.

1. INTRODUCTION

OH-IR sources offer a promising new method to determine the galactic distance scale because their distances can be estimated in a direct way. The twin-peaked OH 1612 MHz maser emission comes from a thin shell of OH which is produced when H_2O molecules in the cool circumstellar envelope are photodissociated by the surrounding UV radiation field (Goldreich & Scoville 1976; Huggins & Glassgold 1982). The OH is excited by far infrared radiation from the star and inner dust shell to produce the 1612 MHz maser (Elitzur 1982). The angular radius of the OH maser shell can be measured accurately with radio interferometers such as MERLIN of the VLA (Diamond et al. 1985). As the masers are pumped by the infrared radiation so they follow the stellar cycle of the long-period variable star. This gives rise to a phase-lag (typically a few weeks) between the emission from the near and far sides of the shell. The phase-lag can be determined by monitoring the OH emission, and together with the angular size measurement this yields the stellar distance (Herman 1983). The method involves only the one assumption of a spherically symmetric maser shell, and this assumption can be checked directly from the data. The phase-lag should vary linearly with velocity across the OH spectrum, and the OH channel maps should show slices through the shell with apparent radius related in a simple way to the velocity. In the best cases the stellar distances can be determined to ∿5%.

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2. OBSERVATIONS

A collaborative project was started in 1985 at Jodrell Bank and Hartebeesthoek Radio Astronomy Observatory to study two groups of OH-IR sources and measure their distances. The first group of optically visible stars are also being monitored simultaneously at near infrared wavelengths at SAAO. These data will provide an independent check on the established period-luminosity relation for long period variables (Feast 1987). The second group of nine OH-IR sources which I want to talk about today lie within three degrees of the galactic centre. Most are believed to be galactic bulge sources because of their high velocities. OH monitoring observations are being carried out fortnightly at Hartebeesthoek, with backup at Jodrell Bank to cover the inevitable gaps. This is the most intensive OH-IR monitoring experiment undertaken to date, but covers only a small number of sources.

MERLIN observations have been made of the sources using four telescopes, with an angular resolution of 0.3x0.6 arcsec. Some of the unresolved sources were reobserved this year with longer baselines to Cambridge. This gives an improved angular resolution of 0.2x0.4 arcsec.

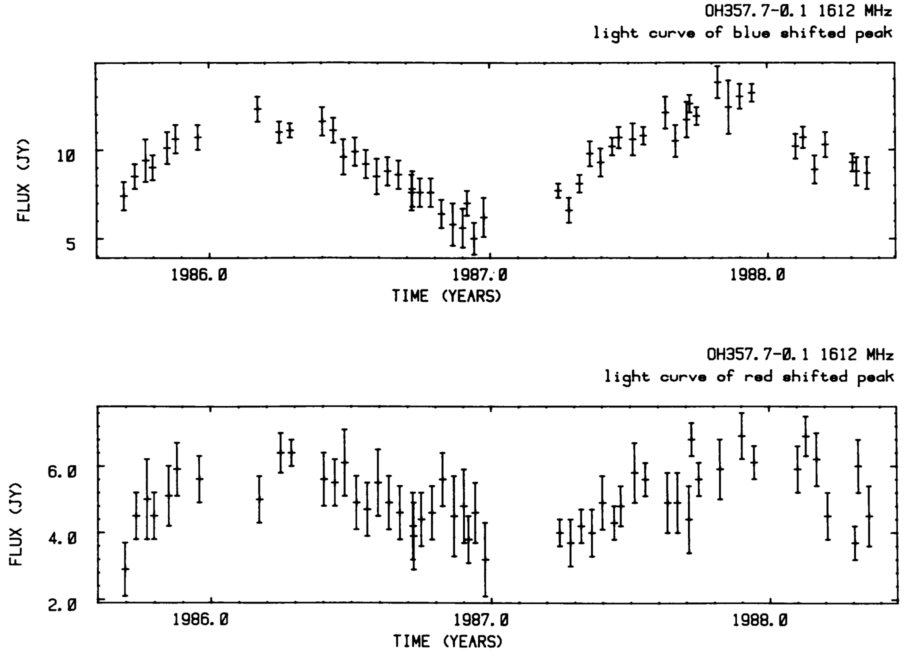

Fig. 1 OH "light curve" for OH357.7-0.1, showing the peak flux densities of the red- and blue-shifted peaks as functions of time.

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3. PRELIMINARY RESULTS

Results so far are encouraging. Most sources are varying, and preliminary phase-lags have been estimated for half of them, with values ranging from 14 to 36 days. These are typical of OH shell sizes elsewhere in the Galaxy (Herman 1983). One of the sources, OH357.7-0.1 has already completed a cycle. Its OH "light curve" is shown in Fig.1.

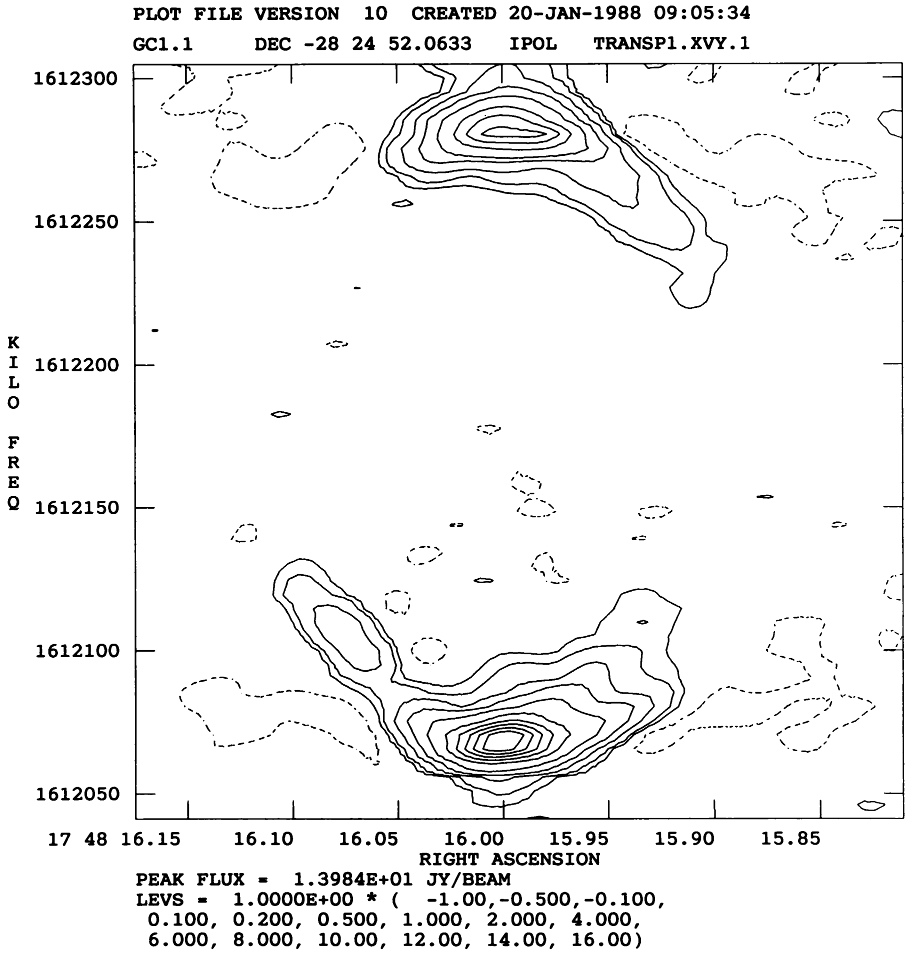

Fig.2 MERLIN map of the source OH1.1-0.8 showing OH emission as a function of right ascension and frequency. This is effectively a position-velocity slice through the centre of the OH maser shell. The shell diameter is estimated by fitting an ellipse to this map.

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Despite the difficulties of mapping at low elevations it has proved possible to make satisfactory MERLIN maps and estimate shell sizes, even for sources which reach a maximum elevation of only 6°. Fig.2 shows an example of a position-velocity slice through a well resolved shell. In this case the dynamic range is about 100:1. A preliminary phase-lag for this source shows that it is at a distance of only 2 kpc, as was expected because of its low velocity and high OH flux. The high-velocity sources which are undoubtedly in the galactic bulge have shell sizes comparable to the MERLIN beam. The source OH357.7-0.1 is barely resolved even on Cambridge baselines. Channel maps show only single broadened gaussians which move about in position at different velocities. The sizes of the gaussians increase systematically towards the central velocity. The shell size is estimated to be about 0.4 arcsec from both these aspects. Combining this with the preliminary phase-lag gives a distance of 10±5 kpc. It is hoped that the error will decrease as more monitoring data accumulate. VLBI data may also be needed to give a better angular diameter measurement.

Final results from the project are expected in 1990. By then we hope to have set up a second-generation experiment using a larger sample of more carefully selected OH-IR sources.

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