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A New, Systematic Search at 1612 MHz for OH/IR Stars in the Inner Galaxy

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1. Introduction

We have surveyed the inner part of the Galaxy for OH 1612 MHz maser emission from OH/IR stars. The full survey is expected to give around 2000 detections. Here we report initial results for the Bulge region between $|l| < 10°$ and $|b| < 3°$.

2. Data

The observations discussed here were taken with the Australia Telescope Compact Array in Oct-Nov 1993. For each field we used a total integration time of 8 min. spread over an hour-angle range of 12 hours in intervals of an hour. Interference in the 1612 MHz band is a major concern in this program - it is ubiquitous for the shorter baselines. Another concern is the beam-pattern resulting from taking short cuts spread over 12 hours, with a one dimensional array. This causes sidelobe patterns which can easily lead to spurious detections. In addition to these problems, the size of the data set calls for special reduction techniques. We have developed a non-interactive method that is not I/O intensive and is well suited for use on supercomputers. To identify the OH/IR stars, all fields are 'skimmed' at successively weaker levels, subtracting point sources at the positions of the highest peaks in the fields, until we reach the (known) 3 σ level. Our method reduces the data reduction time by a factor of eight whilst giving comparable results to conventional cleaning methods. The disk space required is reduced by a factor of 100.

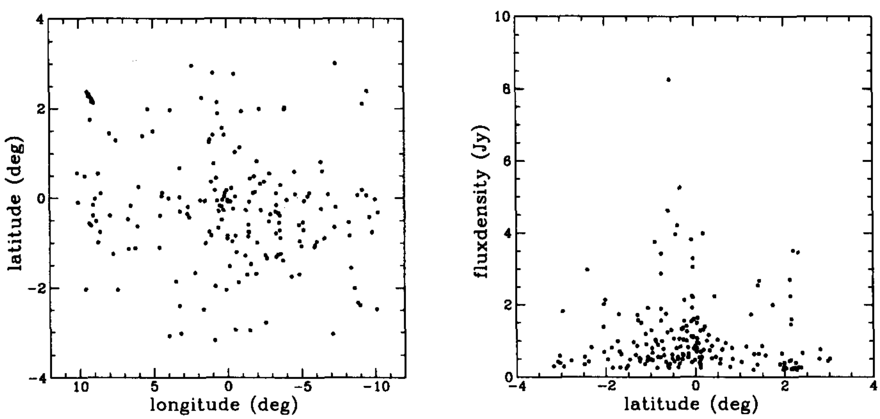
The results shown here are for detections above 4σ ($\sim$ 150 $-$ 200 mJy). The number of OH/IR stars found is 202, of which 104 have double peaks with outflow velocities between 4 km s^{-1} and 30 km s^{-1}. The mean outflow velocity of the 104 stars is 14 km s^{-1}. These numbers are consistent with values obtained from other observations (e.g., te Lintel Hekkert et al. 1989; 1991 and references therein). In Fig. 1 the 202 stars are plotted in longitude versus latitude. It should be noted that most of the single-peaked stars are detected in a second peak in the next pass, since this peak is weaker. We do not show the results of the last pass here since it has not been fully reduced. The stellar velocity is only known for double-peak OH/IR stars. They form a system with solid body rotation of $\sim$ 12 km s^{-1} kpc^{-1} and a velocity dispersion along the line of sight of $\sim$ 100 km s^{-1}. We derived the same quantities for 63 double peaked stars that are closer to the plane - $|b| < 1°$. Their solid body rotation is much higher, ~ 25 km s^{-1} kpc^{-1} , and the velocity dispersion is somewhat lower, ~ 90 km s^{-1}.

Statistically, the outflow velocity is a measure of the age of an OH/IR star. There is a relation between outflow velocity, stellar luminosity and metallicity (or gas/dust ratio μ) of the shell :

$$\mu \propto L_*^{0.5} v_{exp}^{-2}$$

On average, a lower outflow velocity will indicate an older star. Another quantity that is statistically related to the age of a star is its latitude. An older star will have more time to move out of the galactic plane by means of diffusion. So we expect that with latitude the average outflow velocity and the average luminosity of the stars decreases. This effect is indeed seen, as in previous samples of OH/IR stars (e.g., te Lintel Hekkert et al. 1989; 1991). In Fig. 2 the OH-fluxdensity is plotted as a function of latitude to indicate this. For sources in the galactic Bulge, the OH-fluxdensities are not strongly dependent on the distances, and so can be used as a statistical measure of luminosity.

The total number of double peaked sources we expect to find in the Bulge region is 400, three sources per square degree. Next to that there may be some 50 single peaked sources. With the sample of double peaked stars a dynamical analysis of the inner region of the Galaxy will be made.



References

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