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A 3mm SiO maser survey in the galactic bulge region

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Abstract. We have made a blind survey of SiO masers, of the J=2-1 $v = 1$ transition, toward 106 bright OH/IR stars which have been previously detected in the OH main line at 1662 MHz with the ATCA in the galactic bulge by Sevenster et al (2000) and in the galactic disk at J=1-0 ($v = 1 - 2$) line by Miyazaki (2001). A comparison with published data shows that new SiO masers are detected for OH/IR stars in the galactic center, suggesting that those stars are undergoing strong mass loss with dense circumstellar envelopes with apparent angular sizes far smaller than the OH maser shell as obtained by interferometric observations. At the moment, our detection rate is about 23% and it may be increased when the project is completed.

1. Introduction

IRAS sources and OH maser emission, which are associated with asymptotic giant branch stars, are not only good tracers of galactic structure (Habing 1987, Cohen 1990) but are also useful to study the mass loss phenomena and maser pumping mechanisms in evolved stars. Such sources sometimes show luminous OH emission at 1662 and 1720 MHz (Lewis, Eder & Terzian 1990, Sevenster et al. (2000) as well as SiO maser emission at 43 GHz (Nakada 1993) and water maser emission. Indeed, some remarkable protoplanetary nebulae and molecular bipolar outflows have been identified among these objects (Zijlstra et al. 2001).

In order to study the SiO distribution, high angular resolution observations employing modern millimeter VLBI techniques will allow to study the inner

regions of the molecular envelope quite close to the central star (see Doeleman et al, these proceedings) and the detection of 3mm molecular lines are required prior to scheduling VLBI observations.

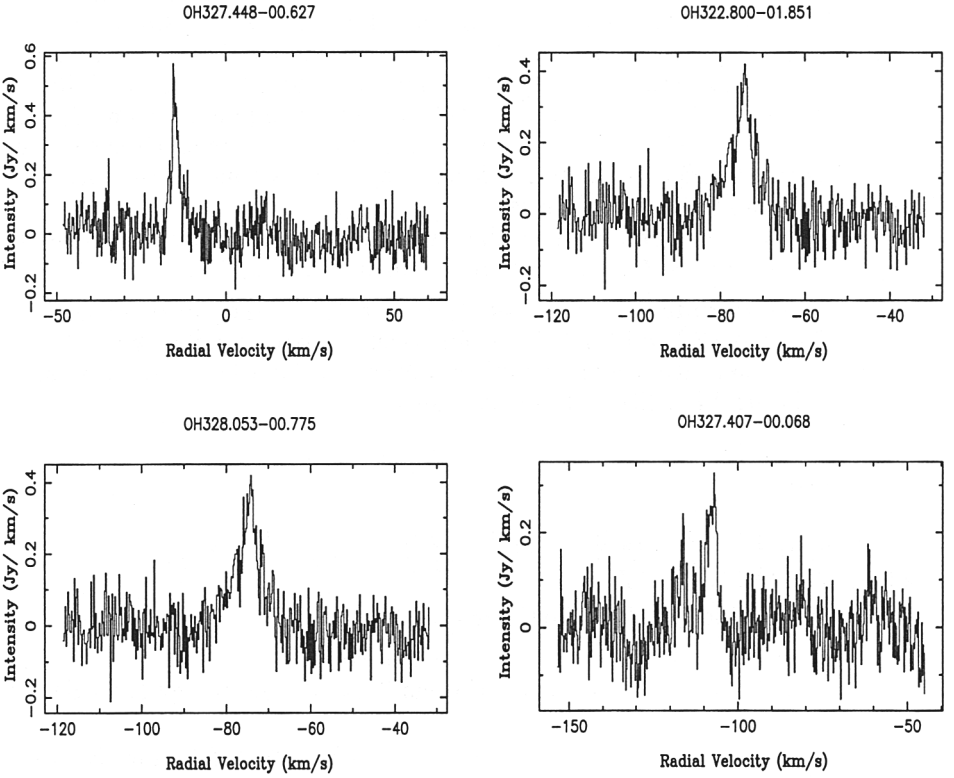

Figure 1. SiO J=2-1 $v = 1$ spectra for a sample of new maser sources in the galactic bulge.

2. Results and discussion

In this paper, we report preliminary results of an ongoing project to detect the SiO maser line at J=2-1, $v = 1$ with a rest frequency of 86,243 GHz for a complete sample of OH/IR stars in the galactic bulge.

Our data show that the total flux density of the SiO lines at 86 GHz are in the range 0.2-4.5 Jy and have been detected well above 12 times the rms

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noise level of 80 mJy. The data was obtained with a 30 minute scan in ON-OFF mode with the Mopra telescope SiS receiver with an average 180 K system temperature. We have found a trend between the SiO maser luminosity and the IRAS integrated colors but we need to complete the sample to confirm that trend. If this is verified, it will support the results from previous surveys that the radiative pump of the J=2-1 SiO line, which may form in molecular clouds with a fairly high IR photon density, is produced in a scenario of direct pumping when the anisotropic trapping of stellar radiation occurs within a region having a very large velocity gradient (Deguchi & Iguchi 1976). Another possibility is an inversion of the vibrational state levels by indirect pumping from an adjacent upper vibrational level $v + 1$ (Kwan & Scoville 1974). A comparison between the line fluxes at different excitation levels may lead to clues to the nature of SiO maser pumping in evolved stars.

We expect to have statistical studies available for publication as soon as the complete sample of 394 OH/IR stars are completed during 2002.

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