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Evolution of Maser/IR Objects with Very Thick Dust Envelopes

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Abstract. Some stellar maser sources at preplanetary stage have very thick circumstellar envelopes, for which no near-infrared identifications have been made. We investigated such stars at radio/NIR/MIR wavelengths using the NRO 45-m, ANU 2.2-m, UH 2.2-m, and SUBARU 8.2-m telescopes. Furthermore, using the Spitzer/Glimpse survey of the Galactic plane, we found counterparts in the 3.6 micron band for all of the OH/IR objects without previous NIR identification. One of the most interesting objects among these is IRAS 18450−0148 (W43A) with collimated outflows. Their spectra indicate that they have massive thick disks.

Keywords. preplanetary nebulae, masers, circumstellar envelope

1. Introduction

Since the discovery of stellar maser sources (Wilson & Barrett 1968), the identification of optical/infrared counterparts for these has been a long standing issue (Allen *et al.* 1977). Until today, a group of OH/IR objects have been left without near-infrared identification (Jiménez-Esteban *et al.* 2005). Because they are embedded in a very thick dust envelope, spectroscopic observations are hard to perform. As a result, the evolutionary status of these objects is unknown.

We have made a systematic study of such stellar maser sources without near-infrared identification in radio, middle- and near-infrared wavelengths using the Nobeyama 45-m, SUBARU 8.3-m, ANU 2.2-m, UH 2.2-m telescopes (Deguchi *et al.* 1998, Deguchi *et al.* 2001, Deguchi *et al.* 2005). In addition, using the Spitzer/Glimpse survey of the Galactic plane, we found counterparts in the 3.6 micron band for all of the OH/IR objects with no previous NIR identification in $10^\circ < l < 60^\circ$ and $|b| < 1^\circ$.

2. Results and conclusion

A part of the sample we chose for identification in the Spitzer/GLIMPSE survey is summarized in Table 1. One of the most interesting objects among these is IRAS 18450−0148 (W43A), which is known as a water maser fountain with collimated outflows (Imai *et al.* 2002). The detection of SiO maser emission in this object (Nakashima & Deguchi 2003) ensured that this is an evolved star. The Spitzer/Glimpse (4.5/5.8/8.0 μm) and UH 2.2-m JHK color composite images toward this object are shown in Figure 1. The spectral energy distribution of this object exhibits a steep inclination between 3.6 and 5.8 μm. It

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Table 1. Objects newly identified with Spitzer/Glimpse Survey

IRAS name	F_C (Jy)	$log(F_C/F_A)$	$log(F_E/F_C)$	LRS	SiO	H_2O	Comments
18100−1915	13.1	0.167	0.173	39	y		OH 11.52−0.58
18135−1456	26.1	1.416	0.498	79	n	y	OH 15.7+0.8
18198−1249	10.1	0.242	0.340	A	y	n	OH18.30+0.43
18257−1000	9.6	0.172	0.305	39	y	n	OH 21.5+0.5
18286−0959	45.0	0.181	-0.129	A	n	y	OH021.797−00.127
18450−0148	23.9	1.378	0.519	U	y	y	W43A
18460−0151	14.7	0.784	0.176		n	y	OH 31.0−0.2
18488−0107	31.1	1.493	0.196	A	y	n	OH 31.98−0.49
18509−0018	24.9	1.395	0.122	A	y		
18517+0037	25.9	1.413	0.187	A	y	y	OH
19087+1006	3.0	0.594	0.259		n		OH
19112+1220	5.2	0.383	0.058		n		OH
19254+1631	22.1	1.344	0.276	39	y	n	OH 51.8−0.1
19254+1724	3.4	0.675	0.273	74	n	n	OH negative
19440+2251	17.4	1.240	0.158	39	y	n	

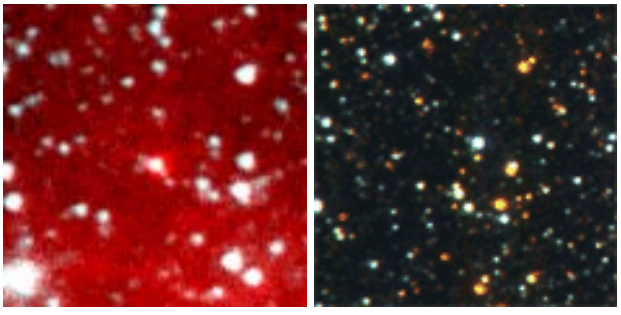

Figure 1. Comparison of the W43A color composite images by Glimpse (left) and UH 2.2-m JHK (right) images (size $\sim 1.5' \times 1.5'$). The central bright red object in the left image is the infrared counterpart of W43A, while it is not seen in the near-infrared image on the right.

indicates that this object has a massive thick disk, which obscures the central hot star. This disk is likely formed by binary interactions. The spectra of the other objects are more or less the same, but the near infrared spectral inclination is less steep. Some of these objects have water maser spectra with high velocity features ($V_e \gtrsim 100$ km s^{-1}). This suggests that they also have thick disks.

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