Two New Outflows

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1 Introduction

High velocity outflows are useful to understanding the essential problems of star formation, e.g. the angle momentum problem and high star formation rate (Lada 1985, Bachiller 1996). Recently we searched a number of H_2O masers and IRAS sources with ^{13}CO J=1-0, $C^{18}O$ J=1-0 and ^{12}CO J=1-0 lines, part of which are characteristic of high velocity (Wu et al. 2000). The results of mapping for IRAS 05339-0646 and IRAS 07028-1100 with the ^{12}CO J=1-0 line are presented.

2 Observations and Results

Observations for IRAS 05339-0646 and IRAS 07028-1100 were made with 13.7 m millimeter wave telescope at QingHai Station of Purple Mountain Observatory in 2001. The 7×7 points maps of IRAS 05339-0646 and IRAS 07028-1100 were centered at $\alpha(1950) = 05^{\rm h}33^{\rm m}57.9^{\rm s}, \delta(1950) = -06^\circ 46' 33.0''$ and $\alpha(1950) = 07^{\rm h}02^{\rm m}51.9^{\rm s}, \delta(1950) = -11^\circ 00' 05.0''$, respectively. The grid spacing was $1'$, and the integration time was 2 minutes for each position. Data were reduced with Drawspec software package. Winsurf and Origin were used for analyses of the contours and spectra.

We analyzed every CO spectrum, then calculated emission intensities and made contours for the two sources. Both of them have the high velocity, large measurable extents and the bipolar structure. All these suggest that the wings result in outflow motions rather than rotation, turbulence or collapse (Lada 1985, Myers 1988).

Figure1 is contours of these two sources, respectively. Symbol triangle, plus, square and diamond represent IRAS sources, maser, HII region and HH object, respectively. IRAS 05339-0646 locates in Ori A cluster. A compact core centered on ($\alpha(1950) = 05^{\rm h}33^{\rm m}57.9^{\rm s}, \delta(1950) = -06^\circ 46' 33.0''$) was measured with $NH_3(1,1)$ line (Jijina et al. 1999). Simbad data show that there are one IRAS source, nine radio continuum, eight H_2O masers, one HII region and twenty-two HH objects. HH objects are lined up in south-north direction, which are the evidence of jet driven.

There is another IRAS source, i.e., IRAS 07027-1101 near IRAS 07028-1100. From IRAS Point Source Catalogue, the fluxes of this two IRAS sources at 12, 25, 60, 100 μm are 0.2893, 1.491, 35.09, 218.0 Jy and 1.858,6.319, 35.09,121.7 Jy, respectively. The fluxes at 12, 25 μm of IRAS 07027-1101 are smaller than those of IRAS 07028-1100, but the flux at 100 μm is larger than latter, which suggest that IRAS 07028-1100 is older than IRAS 07027-1101, that is, the former evolves earlier than the latter.

Using the method by Goldsmith et al.(1984), we calculated the outflow parameters. Under the assumption of local thermodynamic equilibrium (LTE) and the wing being optical thin, the total column density of CO molecules can be obtained as below:

$$N_{\rm CO} = \frac{4.2 \times 10^{13}}{eXp(-5.5/T_{\rm ex})} T_{\rm ex} \int T_R(v) dv ({\rm cm}^{-2})\,,$$

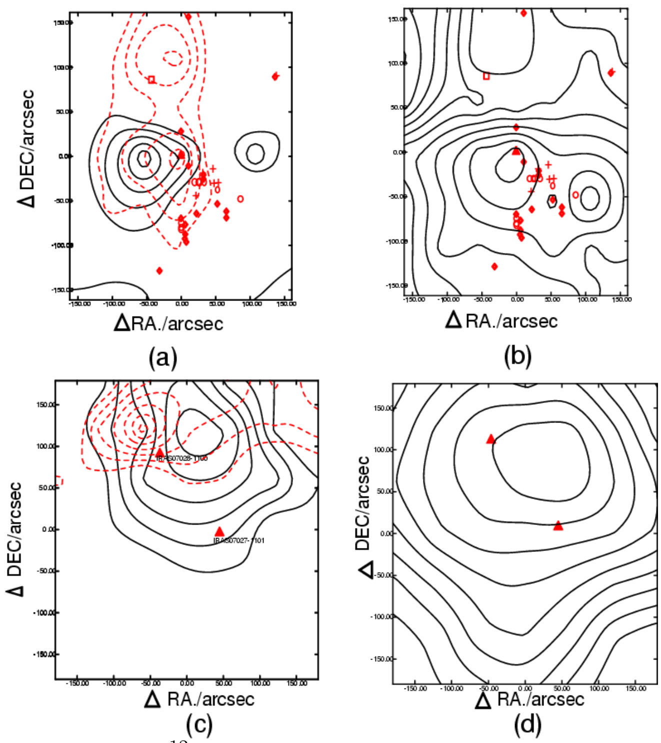

Fig. 1 (a) Contour map of ^{12}CO J=1-0 line wing integrated intensities for IRAS 05339-0646. The blue wing contours (real line) and the red wing contours(dashed line) start at 12 and 8 Kkms^{-1} and increase at step of 2 Kkms^{-1},respectively (b) Contour map of ^{12}CO J=1-0 core integrated intensities for IRAS 05339-0646. The contours start at 120 Kkms^{-1} with 10 Kkms^{-1} spacing. (c)Contour map of ^{12}CO J=1-0 line wing integrated intensities for IRAS 07028-1100. The blue wing contours (real line) and the red wing contours (dashed line) start at 22 and 10 Kkms^{-1} and increase at step of 4 and 1.5 Kkms^{-1}, respectively. Contour map of ^{12}CO J=1-0 core integrated intensities for IRAS 07028-1100. The contours extend from 70 Kkms^{-1} with 10 Kkms^{-1} spacing.

Here, $T_{\rm ex}$ is excited temperature. We take $T_{\rm ex}$ as 27 and 15 K for IRAS 05339-0646 and IRAS 07028-1100. If we further assume a CO abundance $X_{\rm CO} = [{\rm CO}]/[{\rm H_2}] = 10^{-4}$, the column density of the HV gas is $N = N_{\rm CO}/X_{\rm CO}$. Outflow mass M is obtained by summing the products of the column density and the area of all detected points in the map. The momentum P and energy E of the outflow are respectively proportional to the quantities $\sum \int T(v) v dv$ and $\sum \int T(v) v^2 dv$ and can be evaluated similarly to the mass. The characteristic velocity of the wing is given by V=P/M. A dynamic time scale can be determined by $t_d = R/V$, where R is mean size of the outflow. We can estimate the force required to drive the outflow by $F = P/t_d$. The mechanical luminosity and the mass loss rate of the central star of the outflow are $L_{\rm mech} = E/t_d$ and $M_{\rm loss} = P/(t_d v_w)$, where the final wind velocity is taken to be $v_w = 100\,{\rm km/s}$. The results of calculation are listed in Table 1.

The parameters of the central infrared sources are given in Table 2, where the fluxs are taken from the IRAS PSC and the bolometric luminosities are calculated by using the formula of Casoli et al (1986).

Table 1 Outflow parameters

Source Name	size (pc)	M ($M_\odot$)	P ($M_\odot$ kms^{-1})	E (erg)
05339-0646	0.3	3.5	32	2.4×10^{45}
07028-1100	1.2	44	267	13.5×10^{45}

V (M$_\odot$kms^{-1})	t (yr)	F (kms^{-1}yr^{-1})	L_{mech} ($L_\odot$)	M_{loss} (M$_\odot$yr^{-1})
9.2	4×10^4	0.9×10^{-3}	0.6	0.9×10^{-5}
6.1	24×10^4	1.1×10^{-3}	0.5	1.1×10^{-5}

Table 2 Parameters of the infrared sources

Source Name	D (kpc)	F_{12} (Jy)	F_{25} (Jy)	F_{60} (Jy)	F_{100} (Jy)	L_{bol} ($L_\odot$)
05339-0646	0.5	1.235	5.404	75.9	192.9	54
07028-1100	1.4	1.858	6.319	35.09	121.7	279

From Table 2, we can see that the bolometric luminosities of IRAS 05339-0646 and IRAS 07028-110 are 54 and $279L_\odot$, respectively. The former is a low mass star, and the latter belongs to medium mass star. We also find that parameters of the outflow associated with IRAS 07028-1100 are larger than those of IRAS 05339-0646. Both of them are lower than that of high mass outflows (Wu et al. 1996).

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