Configuration and Distribution of High Velocity Molecular Outflows

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Abstract We calculate collimation factors of bipolar outflows and present statistical relationships between the collimation factors and masses of high-velocity molecular outflows in star formation regions as well as the luminosity of infrared source and angular diameters. The collimation histogram shows that low mass outflows have better collimation. The distribution of outflows in the Galaxy is also presented.

1 Introduction

So far more than 350 molecular outflows related to star formation have been reported and mapped in CO ($J = 2-1$ or $1-0$) lines. Collimation factor is a morphologic parameter, probably referring to activity of the proto star and its interaction with surrounded molecular clouds.

Our statistics cover more than 200 references with mapped molecular outflows in star formation regions. The final sample includes 298 bipolar outflows, 41 monopolar ones (17 with only blue lobes and 24 only red lobes discovered) and 4 multipolar ones.

In this paper, we calculate of collimation factors from the contour maps, then discuss the collimation factors statistically. The distribution of outflows in the Galaxy is presented as well.

2 Collimation Factor

We derived the collimation factor in the following way: take existing survey maps of outflow region; measure its major axis,$D_{\max}$; assuming that the region is an ellipse, derive minor axis of the ellipse,$D_{\min}$ from the map. In order to take out the mapping uncertainty of the telescope beams, we let $2R_{\max} = \sqrt{D_{\max}^2 - \theta_{\rm FWHM}^2}$, so as to $R_{\min}$, where $\theta_{\rm FWHM}$ is telescope beam width; then the collimation factor is finally defined by $R_{\max}/R_{\min}$ (Bally & Lada, 1983) .

3 Statistical Results

The distribution of collimation factor is showed in Figure 1. According to this histogram, low mass outflows appear in the region 2.0-2.5, while high mass outflows in the region 1-1.5. So the high mass outflows have worse collimation in general, i.e. they look rounder than low mass outflows.

Collimation factor bears no relation with luminosity of outflow source according to our statistical calculation. It is comprehensible that high mass flows generally have smaller angular radii, which indicates they are further.

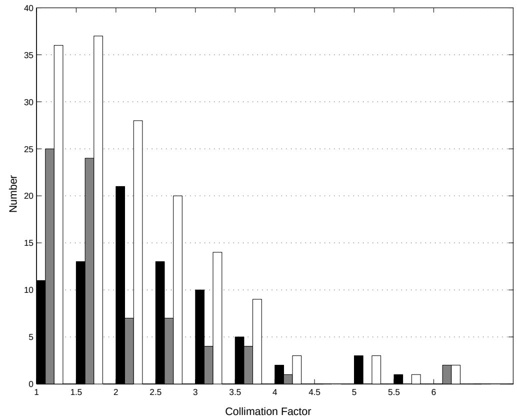

Fig. 1 Distribution of collimation factors. Low mass outflows ($L_{bol} < 1000L_{\odot}$) are in black, high mass ($L_{bol} > 1000L_{\odot}$)in pale grey and the total in white.

4 Distribution of Outflows in the Galaxy

With the origin in the sun and the X-axis pointing to the centre of the Galaxy (GC is at (8,0)), outflow sources are plotted face on (Fig. 2). We can see that low mass outflows are closer to the Sun and high mass flows scatter approximately from several hundred pc to ten thousand pc.

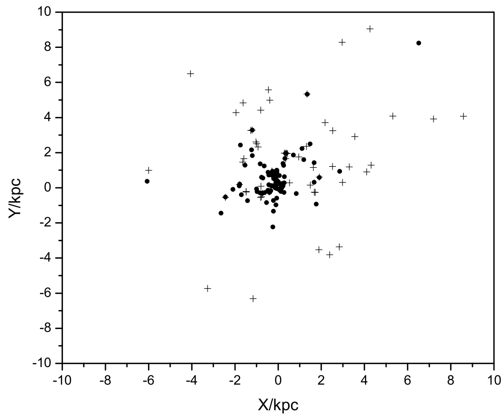

Fig. 2 Outflows distribution in the Galaxy. The sun is at (0,0) and GC at (8,0) Low mass outflows are plotted in dot and high mass in cross.

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References

Bally J., Lada C.J., ApJ, 1983, 265, 824