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Morphokinematic properties of the 21 micron source IRAS 22272+5435

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Abstract. We obtained a high-resolution CO map of IRAS 22272+5435 in the CO $J = 2$–1 line using CARMA. The target exhibits a second biggest angular size of the circumstellar molecular envelope among known 21 μm sources. In the preliminary results, we found that the CO properties of IRAS 22272+5435 is clearly different from those of IRAS 07134+1005, which is another well-investigated 21 μm source. For example, elongations seen in the mid-infrared and CO images are extended in mutually perpendicular directions, although in case of IRAS 07134+1005 the CO feature coincides well with the mid-infrared structure.

Keywords. stars: AGB and post-AGB, stars: carbon, stars: individual (IRAS 22272+5435), stars: imaging, stars: kinematics, stars: winds, outflows

1. Introduction

The target is a proto-typical 21 μm source: i.e., a carbon-rich proto-planetary nebula (PPN) with an unidentified mid-IR feature at 21 μm (see, e.g., Kwok *et al.* 1989). The 21 μm sources are a fascinating sample to investigate the metamorphosis of intermediate-mass evolved stars, because they are lying within a particular narrow evolutionary stage.

A recent radio CO observation of IRAS 07134+1005, another typical 21 μm source, revealed an expanding torus, but did not exhibit a jet (Nakashima *et al.* 2009), even though a bipolar jet is often detected together with a torus in PPNe. We have suggested that this phenomenon might be a common characteristic of 21 μm sources, but of course we need to investigate more 21 μm sources in radio CO lines to compare the morpho-kinematic properties. However, the angular size of the circumstellar envelopes of 21 μm sources is intrinsically too small to be resolved by conventional radio interferometers. So far, only IRAS 07134+1005 has been resolved in previous radio CO mapping.

2. Results and Discussion

In this project, we have obtained a high-resolution CO map of IRAS 22272+5435 using the Combined Array for Research in Millimeter-wave Astronomy (CARMA). The target exhibits a second biggest size of the circumstellar envelope among known 21 μm sources. In the preliminary results, we found that the CO properties of IRAS 22272+5435 are clearly different from those of IRAS 07134+1005. For example, elongations seen the mid-infrared and CO images are extended in mutually perpendicular directions, although in case of IRAS 07134+1005 the CO feature coincides well with the mid-infrared structure. Notable results are summarized as follows:

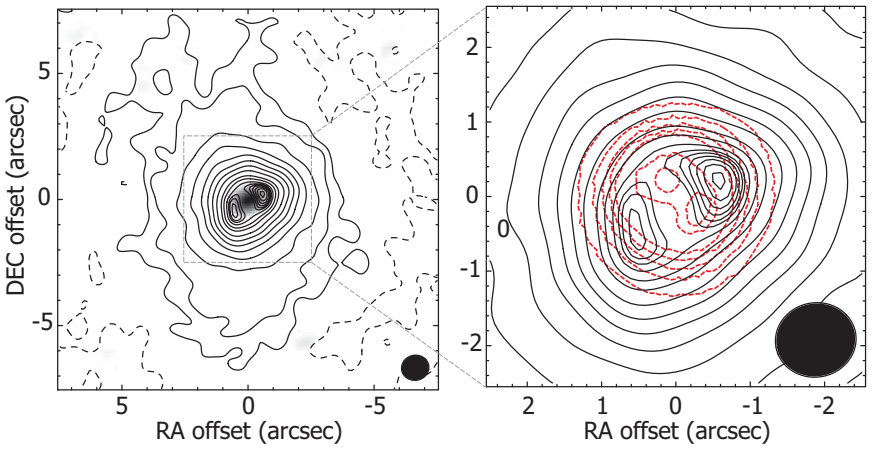

Figure 1. *Left:* total flux intensity map in the ^{12}CO $J = 2$–1 line superimposed on the 1 mm radio continuum image (gray scale). The contour levels are 5, 10, 20, 30, 40, 50, 60, 70, 80, 85, 89, 91, 92, 93, 94, 95 and 96 σ, and the 1σ level corresponds to 1.01×10^{-2} Jy beam^{-1}. The dashed contour correspond to -3σ. The FWHM beam size is located in the bottom right corner. *Right:* total flux intensity map in the ^{12}CO $J = 2$–1 line superimposed on the mid-infrared 12.5 μm image (red dashed contour) taken from Ueta et at. (2001). The contour levels of the CO image are the same as the left panel.

(1) The CO structure is elongated in the north-west to south-east direction, and we see separated two intensity peaks along with this direction in the velocity integrated intensity map (see, Figure 1). This characteristic is reminiscent of the CO $J = 3$–2 map of IRAS 07134+1005, which can be explained with an expanding torus (and expanding sphere; Nakashima *et al.* 2009).

(2) However, the resolved CO structure of IRAS 22272+5435 is out of synchronization with the 12.5 μm structure (see right panel of Fig. 1). In fact, the elongation of the CO structure is perpendicular to that of the 12.5 μm structure. (But, we see a week correlation with the optical I-band image, though we do not present the optical image here.)

(3) In case of IRAS 22272+5435, the CO $J = 2$–1 line and 12.5 μm emission might trace different parts of a torus, because those may trace different temperatures. Otherwise, we might see the onset of a molecular jet, which may complicate the CO and mid-IR structure. Careful morpho-kinematic modeling of the CO data may help to consider this problem (Nakashima *et al.*, in preparation).

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