Morphokinematic properties of the 21 micron source IRAS 22272+5435

Jun-ichi Nakashima¹, Sun Kwok¹, Bosco H. K. Yung¹, Yong Zhang¹, Nico Koning² and Nikolaus Volgenau³

¹Department of Physics, University of Hong Kong, Pokfulam Rd., Hong Kong, China email: junichi@hku.hk

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 μ m 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 μ m 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 μ m source: i.e., a carbon-rich proto-planetary nebula (PPN) with an unidentified mid-IR feature at 21 μ m (see, e.g., Kwok *et al.* 1989). The 21 μ m 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 μ m 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 μ m sources, but of course we need to investigate more 21 μ m sources in radio CO lines to compare the morphokinematic properties. However, the angular size of the circumstellar envelopes of 21 μ m 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 μ m 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 midinfrared 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:

²Department of Physics and Astronomy, University of Calgary, Calgary, Canada T2N 1N4
³Owens Valley Radio Observatory, Big Pine, CA 93513, USA

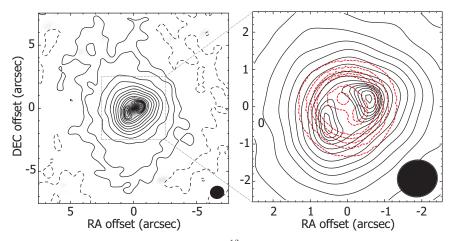


Figure 1. Left: total flux intensity map in the 12 CO J=2–1 line superimposed on the 1 mm radio continuum image (gray scale). The contour levels are 5, 10, 20, 30, 40, 50, 60, 70, 80, 85, 89, 91, 92, 93, 94, 95 and 96 σ , and the 1σ level corresponds to 1.01×10^{-2} Jy beam $^{-1}$. The dashed contour 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 μ m 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 $12.5\,\mu\mathrm{m}$ structure (see right panel of Fig. 1). In fact, the elongation of the CO structure is perpendicular to that of the $12.5\,\mu\mathrm{m}$ 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 μ m 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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