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CIRCUMSTELLAR MOLECULAR GAS OF THE YOUNG STELLAR OBJECT SVS 12

KARL R. STAPELFELDT
University of Massachusetts, Amherst

OVERVIEW

SVS 12 is an embedded infrared source which is the probable exciting star for HH 12. The source has a "class I" IRAS spectrum and about 20 $L_\odot$ luminosity. Differential reddening between the star (J-K$\geq$ 6 mag) and the adjacent infrared reflection nebula (J-K= 3 mag) suggests the presence of dense circumstellar material (Stapelfeldt *et al.* 1991). SVS 12 was observed with the OVRO interferometer in the ^{13}CO 1-0 and CS 2-1 lines and associated continuum, and at the CSO with a bolometer and in the CS 5-4 and CS 7-6 lines.

RESULTS

Bright ^{13}CO emission is distributed in a north-south elongated structure at least 30″ (10,000 AU) in size and which extends beyond the interferometer field of view. Radial velocity changes smoothly from north to south within this structure (ΔV= 2.5 km s^{-1}), suggesting rotation. The morphology is rather different in CS, with a single bright clump associated with the northern ^{13}CO peak and a secondary peak amid HH 12. The CS and ^{13}CO kinematics are identical in the regions where they spatially overlap. No high-velocity gas characteristic of outflow was seen in these lines within the velocity range $\pm$40 km s^{-1}.

No continuum emission from SVS 12 was detected at either 2.7 mm or 3.0 mm; however, an apparently unrelated source is detected 30″ to the NE. At the CSO SVS 12 is strongly detected at 1.1 mm, 0.8 mm, and 0.6 mm, with a spectral index characteristic of thermal dust emission.

DISCUSSION

Using T= 40 K (derived from the measured CS 7-6/5-4 line ratio), the observed ^{13}CO flux of 18.5 Jy km s^{-1} corresponds to a mass of 0.8 $M_\odot$. The CS 2-1 line flux (11 Jy km s^{-1}) implies a mass of 0.65 $M_\odot$ (Nakamura *et al.* 1991). For a β = 2 dust opacity the mass implied by the 1.1 mm CSO continuum flux is 1.0 $M_\odot$. There are thus three independent indications of a substantial mass of material within 5000 AU of SVS 12. A toroid is the simplest explanation for the ^{13}CO velocity structure. Some kind of gravitational binding of this system is needed, for the observed velocity gradient would disperse the system in a few times 10^4 years. If we observe the system from near the orbital plane (as the flattened morphology suggests), the velocity gradient requires a dynamical mass of 5 $M_\odot$.

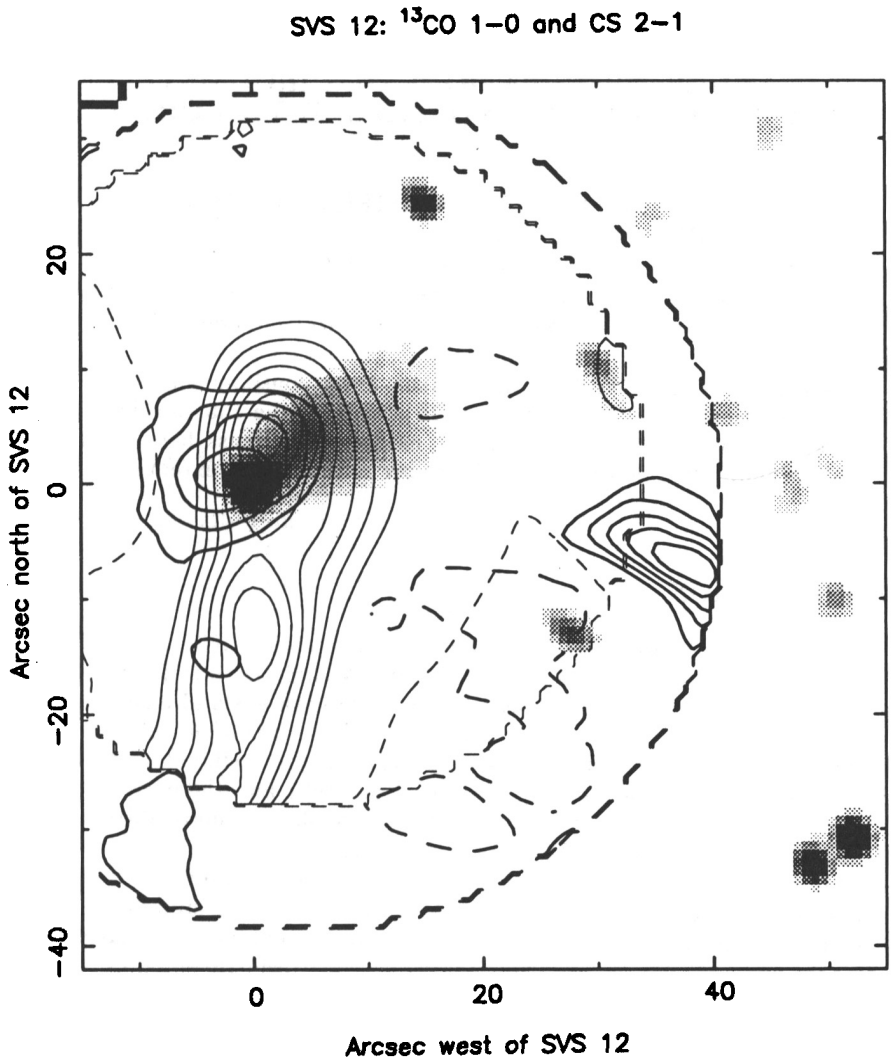

Figure 1: A three-plane overlay showing the CS map (dark contours), the ^{13}CO map (light contours), and a near-infrared image at 2.42 μm (greyscale). The large dotted circles indicate the maximum field of view (half-power radius) of the two OVRO maps.

REFERENCES

Nakamura, A. *et al.* 1991 *ApJ*, **383**, L81

Stapelfeldt, K. *et al.* 1991 *ApJ*, **371**, 226

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