Extremely high-velocity HCN emission from L1448C

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A class 0 protostar L1448C was mapped with the SMA in the HCN J=4–3, CS J=7–6, HCO^+ J=4–3, SO $J_K=8_8–7_7$, and ^{29}SiO J=8–7 lines at an angular resolution of 2 arcsecond. The HCN, CS and HCO+ emission mainly comes from three regions; one is centered at the position of the northern protostar L1448C(N), the second one is around the position of another protostellar souce L1448C(S), and the third one is at ~7" south of L1448C(S).

The HCN spectra observed around L1448C(N) show broad wings that extends to ±30 km s^{-1} from the cloud systemic velocity and separate secondary peaks at extremely high velocities (EHV) of ±50 km s^{-1}. The terminal velocity of the EHV HCN emission is comparable to those of the SiO J=8–7 and CO J=3–2 [1]. However, the EHV HCN emission is localized on the compact region of ±2" from the protostar, and does not show the elongated jet-like morphology. The EHV emission is also shown in the SO and ^{29}SiO lines. The spatial distributions of the EHV emission in these lines are elongated along the jet axis, suggesting that these components are the dense part of the jet at the base. The CS and HCO^+ lines are much narrower than the HCN line, and show no hint of EHV component.

The HCN line observed near L1448C(S) shows a steep edge at the cloud systemic velocity and a broad redshifted wing that extends to +60 km s^{-1}. This line profile strongly suggest that the dynamical interaction between the energetic outflow from L1448C(N) and dense gas envelope around L1448C(S). The SO and ^{29}SiO lines observed here exhibit EHV component at +60 km s^{-1} without lower velocity wing component, suggesting that the emission of these lines arises from the jet impacting on the dense gas. On the other hand, the CS and HCO^+ lines exhibit narrow line width of ~2 km s^{-1} centered at the systemic velocity, and are likely to come from the L1448C(S) envelope.

The third component at ~7" south of L1448C(S) is seen in the maps of HCN, CS, and HCO^+. As in the case of the L1448C(S) component, this component appears near the cloud systemic velocity in the CS and HCO^+, while at ~10 km s^{-1} redshifted velocity in the HCN.

Our results suggest that the HCN emission is significantly enhanced in the regions where the energetic jet traced by the SO and ^{29}SiO lines impacts on the dense ambient gas observed in the CS and HCO^+ lines. The origin of the compact EHV HCN component might be the strong shocks in the jet beam at the base.

References

[1] N. Hirano et al. 2010, ApJ, 717, 58.