JOURNAL OF THE KOREAN ASTRONOMICAL SOCIETY
29: S187 ~ S188, 1996

CO OBSERVATIONS OF A HIGH LATITUDE HII REGION S73 WITH HIGH RESOLUTION AUTOCORRELATOR

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ABSTRACT

We have mapped 1 deg^2 region toward a high latitude H II region S73 $(l, b) = (37°.69, 44°.55)$ and associated molecular cloud in ^{12}CO $J = 1 - 0$, and ^{13}CO $J = 1 - 0$, using the 3 mm SIS receiver on the 14 m telescope at Taeduk Radio Astronomy Observatory. A high resolution autocorrelator is used to resolve extremely narrow CO linewidths (FWHP < 1 km/s) of the molecular cloud. Though the linewidths are very narrow, it is found that there is systematic velocity gradient in the molecular gas associated with the H II region. Both of ^{12}CO and ^{13}CO averaged spectra are non-gaussian, and there are obvious blue wings in the spectra. It is remarkable that the linewidths at the blueshifted region are broader than those of the rest of the cloud. The CO emission does match well with the dust emission.

Key Words : Interstellar medium: H II region: molecules: cloud

I. INTRODUCTION

The studies of molecular gas directly associated with OB association and/or H II regions have been done and substantial information from these objects has been obtained for the last two decade (Blitz 1991). Some H II regions blew up significant amount of surrounding molecular gas dramatically, and left little gas. S73 is an H II region located at high latitude in the inner Galaxy; $(l, b) = (37°.69, 44°.55)$ or $(\alpha, \delta) = (16^h09^m00^s.0, 22°00^m00^s)$. The dust emission map presented in Figure 1 shows a very intriguing feature; it has a shell-like structure with some dispersed filaments. Moreover, there is clear obscuration sign in POSS plates. S73 has been located at the highest Galactic latitude among the known H II regions, which is one of the major priviliege to study it without any background contamination problem. Even with this priviliege S73 has never been studied except one point observation in ^{12}CO $J = 1 - 0$ by Blitz, Fich and Stark (1982). We would like to study S73 in multi-wavelengths, including ^{12}CO and ^{13}CO observation, far-infrared data, and H I data. Our major purpose at the first stage is to analyze the dynamics of gas component and the phenomena of interaction between the H II region and surrounding gas. So far very little is known about the overall gas and dust distribution of the region. The study on this region will present a good opportunity to investigate what appears to be the last stage of the star forming process.

II. OBSERVATIONS

We have mapped 1 deg^2 region toward a high latitude H II region S73 $(l, b) = (37°.69, 44°.55)$ and associated molecular cloud in ^{12}CO $J = 1 - 0$, and ^{13}CO $J = 1 - 0$, using the 3 mm SIS receiver on the 14 m telescope at Taeduk Radio Astronomy Observatory (TRAO). We used an autocorrelator with a resolution of 0.05 km/sec per channel, and resampled the data with a resolution of 0.1 km/sec to improve the noise level. Nine hundred spectra for ^{12}CO and about 400 spectra for ^{13}CO were obtained. About 10% of strong ^{12}CO region was not observed for ^{13}CO because of telescope time limit. We are going to complete the rest part in the coming season. All observations were made by position switching between observed positions and reference positions which were carefully selected for free of CO emission. All antenna temperatures are corrected ($\eta_{fss} = 0.63$) and presented in T_R^* (Kutner and Ulich 1981). The average rms of the resampled spectra with 0.1 km/s is $\sim$ 0.5 K in T_R^*.

III. RESULTS AND DISCUSSION

The CO emission of S73 is found to be well extended along the nebulosity surrounded. The CO emission integrated over all velocities, $\int T_R^* dV$, is presented in Figure 1. The peak temperature of 9 K in T_R^* arises at $(\alpha, \delta) = (16^h08^m19^s.3, 22°01^m00^s)$, while the brightest CO integrated intensity arises at $(\alpha, \delta) = (16^h08^m02^s.0, 22°11^m00^s)$. The velocity of the cloud is well confined within very small range (from 2 to 4 km/s). Moreover, the CO linewidths of the molecular gas are found to be extremely narrow (FWHP < 1 km/s), which is much smaller than those ($\gtrsim$ 5 km/s) of giant molecular clouds (GMCs), and even smaller than those ($\sim$ 2 km/s) of local dark clouds. Though the linewidths are very narrow, it is found that there is systematic velocity gradient in the molecular gas associated with the H II region. The mean velocity map represents that the velocity at the position of $(\alpha, \delta) = (16^h08^m00^s.0, 22°15^m00^s)$ is significantly different from those of other part; the former part is more blueshifted (> 0.6 km/s) than the rest of the cloud. It is remarkable that the linewidths at the blueshifted region are broader than those of the rest of the cloud. These facts can be also confirmed with the shape of the spectra

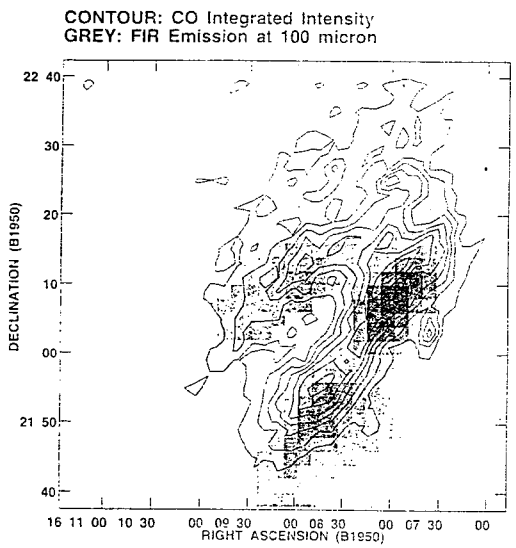

Fig. 1.— The CO integrated intensity map overlayed on FIR emission map at 100 μm. The grey scale ranges from 3 to 11.5 MJy/ster. The first contour is 1.5 K km/s and the increment between contours is 1 K km/s.

(Figure 2). Both of ^{12}CO and ^{13}CO averaged spectra centered on $(\alpha, \delta) = (16^h08^m00^s.0, 22°15^m00^s)$ are non-gaussian, and blue-wings are obvious.

S73 was included in Blitz, Fich, and Stark (1982)'s catalog of H II regions, but the distance to this object has not been reported. However, according to its location at highest Galactic latitude, the distance should be very close, a hundred pc or so. A reliable distance estimate can be obtained throught the deep CCD photometry in several optical bands of *BVRI*. In fact, we are going to image S73 and the associated molecular region with CCD at BOAO.

The dust emission at 100 μm is very dispersed over the region and obvious nebulosity is represented on POSS plate. The size of the nebulosity is about 75′ (Blitz, Fich, and Stark 1982) and it shows a very intriguing feature; it has a shell-like structure with some dispersed filaments. Moreover, The shell-like structure is more or less similar to that of RMC, but in small scale. CO emission does match well with the dust emission boundary (see Figure 1). However, there is systematic tilt between CO emission and FIR emission: The peak of the FIR emission is slightly shifted from CO emission peak. This trend seems to exist over the major part of the molecular gas, which is to be investigated. The FIR emission to CO intensity ratio of 0.7 is twice larger than those of dark clouds with no heating sources. However, it is much less than those of massive star forming GMCs. We will combine continuum data

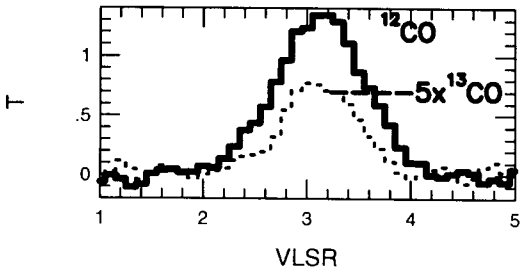

Fig. 2.— The averaged spectra of ^{12}CO and ^{13}CO centered on $(\alpha, \delta) = (16^h08^m00^s.0, 22°15^m00^s)$.

and H I data to clarify the physical properties of this object.

ACKNOWLEDGEMENTS

This work was supported by PBS Research Fund of Korea Astronomy Observatory, which operates with the support from the Ministry of Science and Technology.

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