Determination of the ^{13}C isotopic ratios of HC_3N in the low-mass star-forming region L483

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Linear carbon-chain molecules are characteristic species in interstellar medium. Studies of formation mechanisms for those molecules are crucial steps to reveal chemical evolutions in interstellar medium. Recently, warm carbon-chain chemistry (WCCC) has received attention as a formation mechanism of these molecules in low-mass star-forming regions [1]. L483 is one of these regions [2] and a WCCC candidate source [3]. Although several carbon-chain species were detected in L483 [4, 5], its ^{13}C isotopomers were not observed. Isotopic ratios of carbon-chain molecules reflect their formation mechanism. In the present study, we have observed the J = 10−9 transitions for HC_3N and its ^{13}C isotopomers toward L483 with Nobeyama 45 m radio telescope in March 29-31, 2018. The beam width was 19.0-20.3″, and the main beam efficiency was 0.54. The on-source integration time was 5 hours. Figure 1 shows the observed spectra of the J = 10−9 transition for the ^{13}C isotopomers. The column density and rotational temperature of HC_3N were determined to be 1.9×10^{13} cm^{-2} and 10.9 K, respectively. In limited S/N ratios, the ratios of the ^{13}C isotopomers were derived to be N[H^{13}CCCN] : N[HC^{13}CCN] : N[HCC^{13}CN] = $2.9(5)\times10^{11}$: $6.1(9)\times10^{11}$: $3.6(5)\times10^{11}$ = 1 : 2.1(3) : 1.2(2) in 1-sigma error, where the rotational temperatures were fixed to that of HC_3N. The column densities of H^{13}CCCN and HC^{13}CCN are almost equivalent in various sources, which indicate that HC_3N is produced from a precursor with two equivalent carbon atoms as follows: HCCH + CN → HCCCN + H [6]. On the other hand, the possible in-equivalent ratios in this work might be a result of a reaction with a precursor having two inequivalent carbon atoms as follows: CCH + HNC → HCCCN + H. In future work, to improve the limited S/N ratios, we are planning to observe HC_3N by using Green bank telescope.

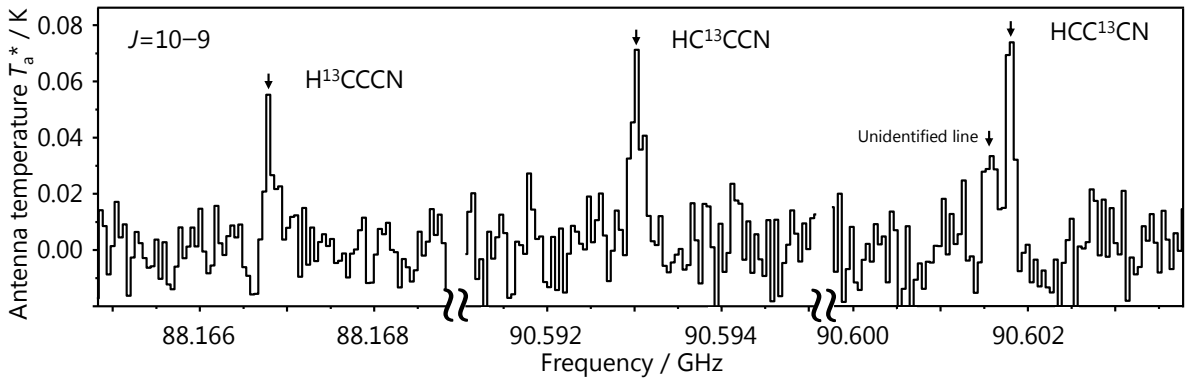

Figure 1: Observed lines of the ^{13}C isotopomers of HC_3N.

References

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