

THE PRECISE RADIO OBSERVATION OF THE  $^{13}\text{C}$  ISOTOPIC FRACTIONATION FOR CARBON CHAIN MOLECULE  $\text{HC}_3\text{N}$  IN THE LOW-MASS STAR FORMING REGION L1527

MITSUNORI ARAKI, *IR Free Electron Laser Research Center, Tokyo University of Science, Tokyo, Japan*; SHURO TAKANO, *College of Engineering, Nihon University, Fukushima, Japan*; NAMI SAKAI, *RIKEN Center for Advanced Photonics, RIKEN, Wako, Japan*; SATOSHI YAMAMOTO, *Department of Physics and Research Center for the Early Universe, The University of Tokyo, Tokyo, Japan*; TAKAHIRO OYAMA, *Faculty of Science Division I, Tokyo University of Science, Tokyo, Japan*; NOBUHIKO KUZE, *Faculty of Science and Technology, Sophia University, Tokyo, Japan*; KOICHI TSUKIYAMA, *Faculty of Science Division I, Tokyo University of Science, Shinjuku-ku, Tokyo, Japan*.

We observed the three  $^{13}\text{C}$  isotopic species of  $\text{HC}_3\text{N}$  with the high signal-to-noise ratios in L1527 using Green Bank 100 m telescope and Nobeyama 45 m telescope to explore the production scheme of  $\text{HC}_3\text{N}$ , where L1527 is the low-mass star forming region in the phase of a warm carbon chain chemistry region.<sup>a</sup> The spectral lines of the  $J = 5-4$ ,  $9-8$ ,  $10-9$ , and  $12-11$  transitions in the 44–109 GHz region were used to measure isotopic ratios. The abundance of HCCCN was determined from the line intensities of the two weak hyperfine components of the  $J = 5-4$  transition. The isotopic ratios were precisely determined to be  $1.00 : 1.01 : 1.35 : 86.4$  for  $[\text{H}^{13}\text{CCCN}] : [\text{HC}^{13}\text{CCN}] : [\text{HCC}^{13}\text{CN}] : [\text{HCCCN}]$ . It was found that the abundance of  $\text{H}^{13}\text{CCCN}$  is equal to that of  $\text{HC}^{13}\text{CCN}$ , and it was implied that  $\text{HC}_3\text{N}$  is mainly formed by the reaction schemes via  $\text{C}_2\text{H}_2$  and  $\text{C}_2\text{H}_2^+$  in L1527. This would suggest a universality of dicarbide chemistry producing  $\text{HC}_3\text{N}$  irrespective of evolutionary phases from a starless dark cloud<sup>b</sup> to a warm carbon chain chemistry region.

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<sup>a</sup>Sakai, N., Sakai, T., Hirota, T., & Yamamoto, S. 2008, *ApJ*, 672, 371

<sup>b</sup>Takano, S., Masuda, A., Hirahara, Y., et al. 1998, *A&A*, 329, 1156