

# Spectral Line Survey Observations toward the Low-mass Star-forming Region L1527 with the Nobeyama 45-m Telescope

K. Yoshida<sup>1,2</sup>, T. Tokudome<sup>1</sup>, N. Sakai<sup>2</sup>, Y. Watanabe<sup>1</sup>, S. Takano<sup>3</sup>, and S. Yamamoto<sup>1</sup>

<sup>1</sup>*Department of Physics, The University of Tokyo, Japan*

<sup>2</sup>*The Institute of Physical and Chemical Research (RIKEN), Japan*

<sup>3</sup>*Department of Physics, General Education, College of Engineering, Nihon University, Japan*

We have carried out spectral line survey observations toward the low-mass star-forming region L1527 with the Nobeyama 45 m telescope in the 3 mm region. L1527 is a prototypical Warm Carbon-Chain Chemistry (WCCC) source, which harbors various carbon-chain molecules and their isomers in a dense and warm region ( $\sim 1000$  au) around the protostar [1]. In this spectral survey covering 80 GHz to 116 GHz, we have detected about 300 spectral lines and have identified more than 60 molecules including minor isotopic species. In this paper, we summarize the result of the line survey.

We have detected many carbon-chain molecules and their isomers. In particular, cyclic-C<sub>3</sub>H and cyclic-C<sub>3</sub>H<sub>2</sub> are found to be abundant in comparison with the other sources, resulting in the first detection of c-C<sub>3</sub>D and c-<sup>13</sup>CCCH<sub>2</sub> in cold clouds [2]. We have also detected the lines of cyclopropanone (c-C<sub>3</sub>H<sub>2</sub>O) and propynal (HCCCHO). We compare the chemical composition of L1527 with those of the well-known hot corino source IRAS16293-2422 and the starless core TMC-1. The chemical compositions of L1527 and IRAS16293-2422 are exclusive to each other: the line survey observations toward IRAS16293-2422 shows rich spectral lines of complex organic molecules and deficient carbon-chain molecules, while the L1527 survey shows an opposite trend [3]. On the other hand, column densities of carbon-chain molecules in L1527 are found to be well correlated with those in TMC-1. When compared with TMC-1, longer carbon-chain molecules and N-bearing carbon-chain molecules tend to be less abundant in L1527. This would be due to the difference in the dynamical time scale of the molecular cloud cores.

NRO3mm\_.eps -

Figure 1: Spectral line survey toward L1527.

## References

- [1] Sakai, N. et al. 2008, ApJ 672, 371
- [2] Yoshida, K. et al. 2015, ApJ 807, 66
- [3] Caux, E. et al. 2011, A&A 532, 23