

Nobeyama 45 m telescope legacy project: Line survey

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Line surveys are of fundamental importance in astronomy not only for complete understanding of molecular abundances, but also for finding out new observational tools (spectral lines) probing interstellar medium. We carried out a new line survey project at the 3 mm region. The new wide band system (2SB receivers, 4-8 GHz IF lines, 3 bit 4 GHz sampling AD converters, and 2 GHz band width x 16 spectrometers) was used in the late stage of the survey, and the survey speed was accelerated. The target sources are the low-mass star-forming region in L1527, the shocked region in L1157 B1, the infrared dark clouds G28.34+0.06, and the external galaxies NGC 1068, NGC 253, and IC 342. The main results are as follows.

(1) L1527: This is an interesting star-forming region with high abundances of carbon-chain molecules [1]. The survey from 80 to 117 GHz has been completed. We detected many lines from 39 species including various carbon-chain molecules, isotopic species (D, ^{13}C) of some carbon-chain molecules, and unidentified species. In particular, we detected the lines of cyclopropanone and propynal as well as those of cyclic- C_3D_2 and ^{13}C substituted cyclic- C_3H_2 .

(2) L1157 B1: This is a prominent region of interactions between a molecular outflow from the protostar and ambient clouds [2, 3]. This is an ideal region to study shock chemistry. The survey was finished from 78.1 to 115.5 GHz. We detected 130 lines from 44 species including CH_3CHO , CH_2DOH , carbon-chains, and PN [4, 5, 6].

(3) G28.34+0.06 (possible high-mass star-forming regions): Three interesting positions called MM1, MM4, and MM9 were selected, and the survey almost covered from 80 to 110 GHz. Toward MM1 and MM4 line wings were found in SiO and so on. These wings indicate outflow activities. In addition, CH_3CHO was detected only in MM1 and MM4, though N_2D^+ was detected only in MM9. Based on these results, MM1 and MM4 are thought to be active and more evolved objects.

(4) NGC 1068 is a nearby galaxy with X-ray radiation from the active galactic nucleus, and NGC 253 and IC 342 are also nearby galaxies with prototypical starbursts. The survey was finished from 85 to 116 GHz. We detected 21-23 species depending on the galaxies including several new detections (e.g. cyclic- C_3H_2 and C_2H in NGC 1068 [7]). The intensities of HCN and CN relative to ^{13}CO are significantly strong in NGC 1068 compared to those in NGC 253 and IC 342.

References

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