Detection of absorption lines of CH_3CN in envelope of Sagittarius B2 (M)

M. Araki,[1] S. Takano,[2] Y. Minami,[1] T. Oyama,[1] N. Kuze,[3] K. Kamegai,[4] and K. Tsukiyama[1]

[1] *Faculty of Science Division I, Tokyo University of Science, Japan*
[2] *College of Engineering, Nihon University, Japan*
[3] *Faculty of Science and Technology, Sophia University, Japan*
[4] *Astronomy Data Center, National Astronomical Observatory of Japan, Japan*

Detections of organic molecules in diffuse and translucent clouds is essential to reveal a history of organic molecules in space. Molecules in these clouds suffer more cooling by radiations and less heating by collisions. However, for acetonitrile CH_3CN, a rotation around a molecular axis cannot be cooled by radiations, and then rotational populations are concentrated to $J = K$ levels. Strong absorption lines from the levels can be produced. To simulate the lines, we formulated this rotational behavior as "Hot Axis Effect" [1]. In this work, to detect this molecule in diffuse and translucent clouds we searched for absorption lines of the $J_K = 4_3$–3_3 transitions at 73.6 GHz toward the galactic center Sagittarius (Sgr) B2(M) and other sources by using Nobeyama 45 m telescope. As a result, the absorption lines having the velocity of 64 km s^{-1} were detected toward Sgr B2(M). The excitation temperature of 2.9 ± 0.5 K, the kinetic temperature of 95 ± 32 K, and the column density of (1.34 ± 0.15) × 10^{14} cm^{-2} were derived for this molecule. The kinetic temperature suggests that the 64 km s^{-1} component is located in the envelope of Sgr B2(M). Thus, the envelope is thought to be a habitat of small complex organic molecules (COMs), which have been detected so far. We also found the similarity of abundances of small COMs between the envelope and the core of Sgr B2(M) and the variety of abundances of them among the envelope and other diffuse clouds.

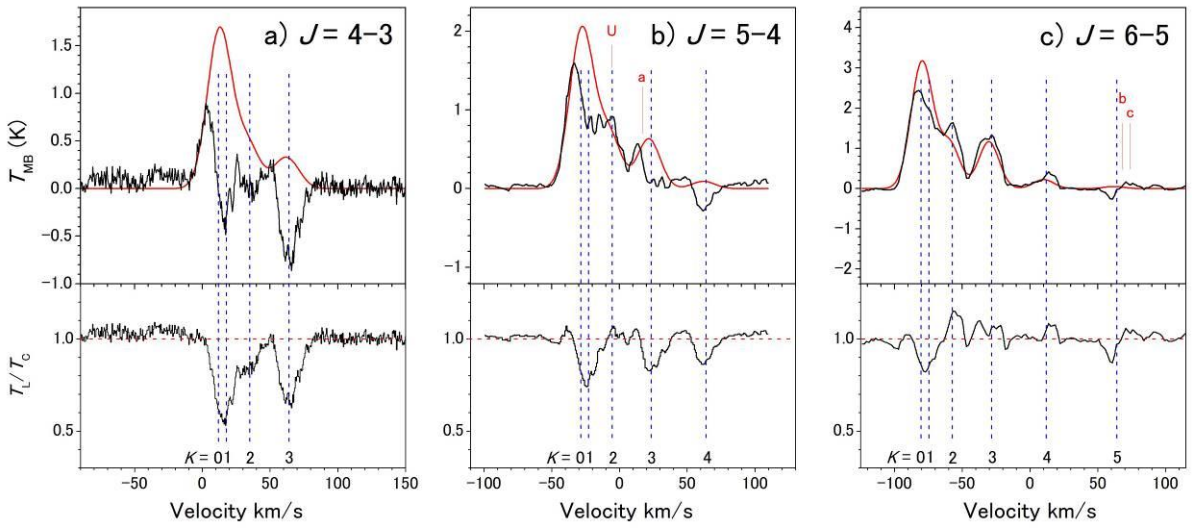

Figure 1: Absorption lines obtained by subtraction of emission lines for CH_3CN toward Sgr B2(M). In the upper panels, the red lines are estimated emission profiles and solid lines are observed profiles. The velocities are based on the frequencies of the transitions from the $J = K$ levels. The spectra of J = 5–4 and 6–5 are from Belloche *et al.* [2]. The red bars marked by the alphabets show emission lines of other molecules.

References

[1] M. Araki *et al.*, 2014, Astronomical Journal 148, 87.
[2] A. Belloche *et al.*, 2013, A&A 559, 47.