Detection of Organic Molecule CH_3CN in Diffuse Clouds toward Galactic Center SgrB2(M)

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Organic molecules have been detected mainly in dense clouds such as circumstellar envelops, dark clouds, and star-forming regions. Note that these clouds are quantitatively local structures of interstellar clouds and the amount of diffuse clouds is estimated to be one or two orders higher than those of dense clouds. As a diffuse cloud is a previous phase of a dark cloud in evolutionary history of an interstellar cloud, detection of organic molecules in diffuse clouds can reveal a longer history of organic molecules. Despite of importance, emission lines from molecules in diffuse clouds are difficult to detect because of inactive excitation by collisions and active cooling by radiations. However, for CH_3CN, a rotation around a molecular axis cannot be cooled by the radiations in diffuse clouds, thus this molecule can be detected by absorption. In our previous work, this rotational behavior was formulated as Hot Axis Effect [1]. In this work, to detect this molecule in diffuse clouds that are more diffuser than the known diffuse clouds carrying organic molecules [2,3], we have been searched a line of the $J_K = 4_3–3_3$ transition of CH_3CN having a strong absorption at 73 GHz toward the galactic center SgrB2(M) by using Nobeyama 45 m telescope. This molecule was detected in the diffuse clouds of the galactic center and the spiral arms of Scutum-Crux arm and Sagittarius arm. The column density in Sagittarius arm, for example, was derived to be 8×10^{16} cm^{-2}. Therefore, we detected an organic molecule in the diffuse clouds that are more diffuser than the known diffuse cloud carrying CH_3CN [2,3].

[1] Araki *et al.*, Astronomical Journal, 148, 87 (2014)
[2] Muller *et al.*, A&A, 535, 103 (2011)
[3] Thiel *et al.*, A&A, 605, 6 (2017)

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