Line Survey Project of External Galaxies with NRO 45-m Telescope

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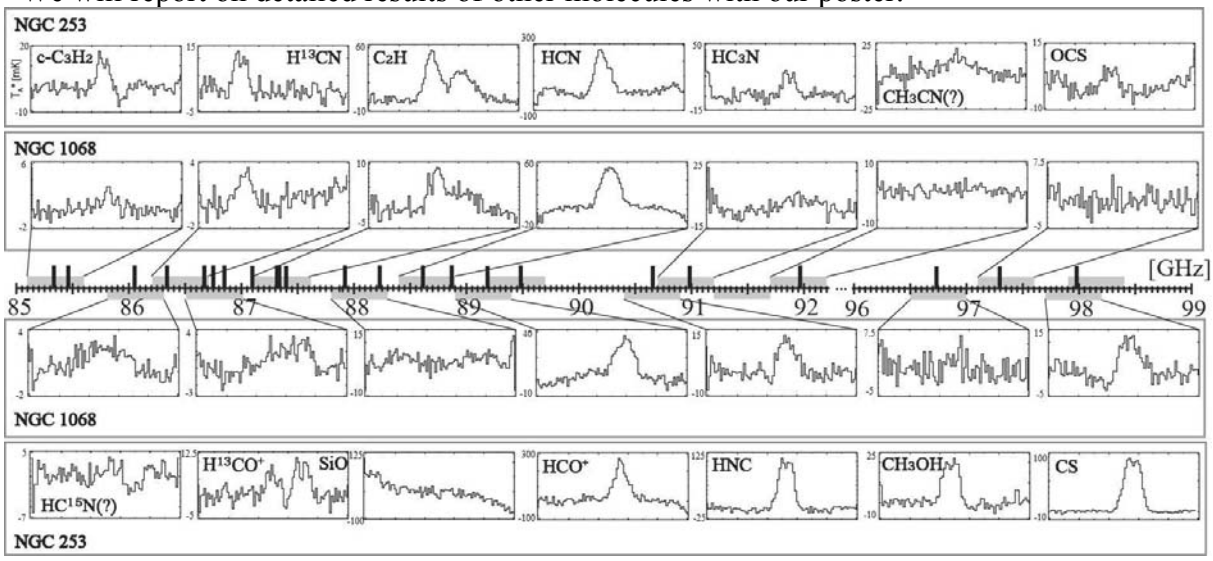
So far about 37 molecules have been detected in external galaxies. Since various galaxies with different environments exist such as those with small or large amount of gas, with starburst and/or Active Galactic Nucleus (AGN), and with interaction, etc., we expect that various interesting phenomena could be observed in interstellar matter in galaxies. To study the effect of AGN on the circumnuclear molecular gas, further observations of molecular lines are indispensable. Therefore, we started a line survey in 3 mm band with the new receiver on the NRO 45-m telescope [1] toward NGC 1068, which is one of the nearest AGN where a presence of X-ray dominated regions (XDRs) has been suggested (e.g., [2][3]). We can make a selective study of the effect of AGN, because a beam size of the 45-m telescope (~ 18″ at 86 GHz) is smaller than the size of circumnuclear starburst ring in NGC 1068 (d ~ 30″). This project is still continuing but we report some of the results from the initial observations.

The observations at the 3 mm region (85.1-92.2 GHz and 96.5-98.4 GHz) were carried out in February to May, 2009 and January to May, 2010. We successfully detected *cyclic*-C_3H_2 ($J_{Ka,Kc}$= $2_{1,2}$-$1_{0,1}$), C_2H (N = 1-0) and $H^{13}CN$ (J = 1-0) for the first time in NGC 1068, and $HC^{15}N$ (J = 1-0) and CH_3OH (J_K = 2_K-1_K) were tentatively detected. In addition, the detection of CS (J = 2-1) has already been reported [4], but we detected for the first time with a single dish telescope in this galaxy. We are also observing NGC 253, which is the prototypical nearby starburst galaxy, as a comparison to study the effect of AGN on molecular abundance. The following results were obtained about the C_2H lines.

(1) Using the fine structure, the optical depths toward NGC 1068 and NGC 253 were obtained to be less than 1. These molecular lines are optically thin in both galaxies.
(2) The column densities are estimated to be 0.9 x 10^{14} and 0.5 x 10^{15} cm^{-2}, respectively, assuming the excitation temperature of 30 K. The latter value is consistent with the value obtained toward NGC 253 from the previous study [5].

We will report on detailed results of other molecules with our poster.



References

[1] T. Nakajima, et al., 2008, PASJ 60, 435
[2] A. Usero, et al., 2004, A&A 419, 897
[3] K. Kohno, et al., 2008, Ap&SS, 313, 279
[4] L. J. Tacconi, et al., 1997, Ap&SS 248, 59
[5] S. Martín et al., 2006, ApJS, 164, 450