

## Variations in the CO<sub>2</sub>/H<sub>2</sub>O ice abundance ratios in nearby galaxies

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Absorption features due to interstellar ices are observed in near- and mid-infrared spectra. Among various parameters about ices, we focus on a CO<sub>2</sub>/H<sub>2</sub>O ice abundance ratio which effectively reflects the ice-forming interstellar environment. In past studies, CO<sub>2</sub>/H<sub>2</sub>O ratios show large variations from object to object in our Galaxy. The cause of the variations is, however, still under debate. In this study, we examine variations in CO<sub>2</sub>/H<sub>2</sub>O ratios in nearby galaxies based on the AKARI near-infrared (2.5-5.0  $\mu\text{m}$ ) spectra for 1031 regions in 158 galaxies. The CO<sub>2</sub>/H<sub>2</sub>O ratios in the galaxies are in a range of 0.05-0.30. In the dataset, we find a positive correlation between the CO<sub>2</sub>/H<sub>2</sub>O ratios and the Br $\alpha$ /PAH 3.3  $\mu\text{m}$  ratios which depend on the massive star-forming activities. Furthermore, we find a positive correlation between the CO<sub>2</sub>/H<sub>2</sub>O ratios and the specific star formation rates of the galaxies, which depend on the evolutionally stage of the galaxies. These results suggest that CO<sub>2</sub>/H<sub>2</sub>O ratios are high in active star-forming regions in young galaxies. It is possible that cosmic-ray induced UV photons due to the massive star-forming activities contribute to the CO<sub>2</sub> formation. Finally, effects of cosmic-ray on the CO<sub>2</sub>/H<sub>2</sub>O ratio are examined by using a gas-grain chemical model. We also show initial results of the model calculations.

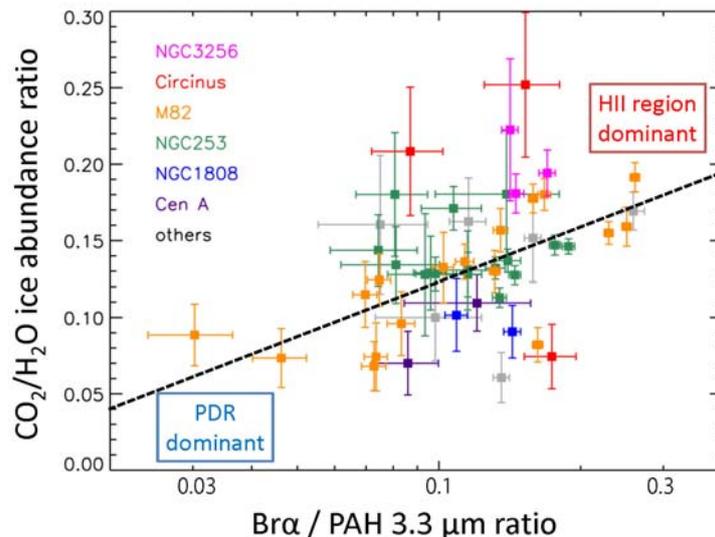


Figure 1: CO<sub>2</sub>/H<sub>2</sub>O ice abundance ratios plotted against the Br $\alpha$ /PAH 3.3  $\mu\text{m}$  ratios for all the regions where H<sub>2</sub>O and CO<sub>2</sub> ices are detected. The dashed line represents the best-fit relation in M82.