AKARI observations of interstellar ices in nearby galaxies: variations in CO_2/H_2O ice abundance ratios

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Near- and mid-infrared wavelength ranges include absorption features due to interstellar ices (e.g., H_2O ice at 3.05 μm and CO_2 ice at 4.27 μm) which are important probes of the interstellar environment. Among them, CO_2 ice is the most important one because CO_2 ice is thought to be a secondary product unlike H_2O ice which is primarily formed on dust grains. Therefore, a CO_2/H_2O ice abundance ratio effectively reflects the ice-forming interstellar environment. In the ice study, CO_2/H_2O ratios in our Galaxy and the Magellanic Clouds have been intensively observed to date, which show large variations from object to object. The cause of the large variations is, however, still under debate.

In this presentation, we report CO_2/H_2O ratios in nearby galaxies based on the AKARI near-infrared (2.5–5.0 μm) spectra for 1031 regions in 158 galaxies. The CO_2/H_2O ratios in our sample are in a range of 0.05–0.30. We find a positive correlation between the CO_2/H_2O ratios and the Brα/PAH 3.3 μm ratios, indicating that hard UV radiation due to massive stars is important to enhance the CO_2/H_2O ratios. Furthermore, we find a positive correlation between the CO_2/H_2O ratios and the specific star formation rates of the galaxies, suggesting that the evolutionary stage of a galaxy is also an important factor to determine the CO_2/H_2O ratio of a galaxy. Based on the results, we discuss implications of the variations in CO_2/H_2O ice abundance ratios for the ice-forming interstellar environment and the galaxy evolution.