AKARI observations of interstellar dust grains in our Galaxy and nearby galaxies

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In star-forming regions, dust and polycyclic aromatic hydrocarbons (PAHs) absorb a significant fraction of stellar ultraviolet photons and re-radiate them in the infrared (IR). Hence the IR luminosities due to dust and PAH emission are both powerful tools to trace star-forming activities in galaxies. Beyond such star-formation tracers, however, spectral information on dust and PAH emission would have much deeper physical implications for understanding the properties of the ISM. With AKARI, the first Japanese infrared astronomical satellite launched in 2006, we have performed a systematic study of interstellar dust grains in various environments of galaxies including our Galaxy. Because of its unique capabilities, such as near- and far-IR spectroscopy combined with all-sky coverage in the mid- and far-IR, AKARI has provided new knowledge on the processing of dust, particularly carbonaceous grains including PAHs, in the interstellar space.

For example, we find that copious amounts of large grains and PAHs are flowing out of starburst galaxies by galactic superwinds, which are being shattered and destroyed in galactic haloes. With near-IR spectroscopy, we detect notably strong aliphatic emission relative to aromatic emission in the halo of M82, indicating structural changes of hydrocarbon grains. We also detect strong aliphatic emission from the inner bar of NGC 1097, which indicates that the gas and dust in the bar are in a turbulent motion, likely fueling the central AGN from the starburst ring. From early-type galaxies, we detect PAHs which show spectral features with unusual inter-band ratios and spatial distributions more centrally-concentrated than large grains, again demonstrating importance of material processing in the interstellar space.

AKARI is capable of far-IR spectral mapping with the imaging FTS. For some spectra obtained near the Galactic center, we find that there is a significant excess on top of the modified blackbody continuum around 110−130 μm. We find that a dust model including large graphite grains can at least reproduce the observed spectrum with the excess emission fairly well. The detection of the excess feature from this region might be related to the (past) activity of the Galactic center, because thermal annealing with very high temperatures is needed to graphitize carbonaceous grains. This result may also be related to the abundant PAHs at the centers of early-type galaxies, because many early-type galaxies are known to possess galactic nuclei with declining or ceased activity like our Galaxy.

In this talk, we review the results obtained from our AKARI observations on the processing of interstellar dust grains in various harsh environments of our Galaxy and nearby galaxies, together with our future prospect for this topic with SPICA, which is scheduled to be launched in the early 2020’s.