Properties of dust and PAHs in various environments of nearby galaxies

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In star-forming regions, dust and polycyclic aromatic hydrocarbons (PAHs) absorb a significant fraction of stellar ultraviolet (UV) 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. However they are not merely tracers of star-formation activity. Spectral information on the dust and PAH emission would have much deeper physical implications for understanding the properties of the ISM. External galaxies provide us with a much wider range of the ISM physical conditions than our Galaxy.

For example, Spitzer mid-IR spectroscopy has shown a variety of the PAH emission features for various types of galaxies, which reflects significant changes in the properties of PAHs, such as an ionization state and a size distribution. AKARI near-IR spectroscopy has revealed spatial variations in the ratio of the aromatic to the aliphatic hydrocarbon spectral feature in galaxies, indicating structural changes of carbonaceous grains in shocked regions. AKARI also detects near-IR absorption features due to interstellar icy grains from many nearby galaxies, providing unique tools to probe the chemical evolution of the ISM.

The relation of PAH to far-IR dust is another important probe to study the conditions of the interstellar environments. In general, PAHs and far-IR dust are mixed well in the ISM, producing global correlations between their IR luminosities. In local areas within a galaxy, however, their abundance ratios are expected to vary considerably due to interactions with interstellar shocks, hard UV radiation fields and diffuse X-ray hot plasmas. Until recently, spatial resolutions in the far-IR were extremely poor compared with those in the near- and mid-IR. Herschel now enables us to make a detailed comparison of spatial distributions of far-IR dust and PAH emission within a galaxy.

In this talk, starting from those in the central region of our Galaxy, I will review recent observational results on the properties of dust and PAHs exposed to various environments of nearby galaxies, which range from passive elliptical galaxies to starburst galaxies with galactic superwinds, and (ultra-)luminous infrared galaxies. In particular, I will focus on variations in the PAH spectral features and PAH to far-IR dust ratios to discuss their implications for the processing of carbonaceous grains in harsh interstellar environments.