P053-002 Room: C401 Time: May 29 13:45-14:15

Latest Observations of Interstellar Dust Grains

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Recent observations of interstellar solid particles (hereafter ``interstellar dust'') are reviewed. Interstellar dust is believed to be small particles in 0.01-0.1 micron size. The composition of interstellar dust has been challenged by recent observations of interstellar elemental abundance, but major components are believed to be carbonaceous grains and silicate particles. Latest high energy-resolution X-ray spectroscopic observations will provide a promising opportunity to estimate the abundance of gas and dust in interstellar space separately.

Lattice vibration modes of solids are usually located in the infrared region and thus infrared observations of the emission from dust particles are one of the most crucial means to identify their composition. Observations with the Infrared Space Observatory (ISO) have detected a series of crystalline silicate bands in the 20-40 micron region around old stars as well as young stars of medium mass, in addition to the smooth feature attributed to amorphous silicate. Latest observations with the Subaru telescope have also indicated crystalline features in 10 micron in young stars of about a solar mass. These results provide an important clue to the crystallization in the interstellar space and an observational connection to the mineralogy in the solar system. Observations of zodiacal emission in the mid-infrared by the first Japanese infrared mission IRTS also suggest the presence of small crystalline silicate particles in the solar system.

Only magnesium-rich silicate (forsterite or enstatite) bands have been detected by ISO. The location of iron in interstellar dust is not yet identified. A broad feature around 22 micron found in a supernova remnant may be attributed to iron oxide grains. A similar feature has also found in star-forming regions, which may be the first case to connect the interstellar dust to the formation site. A latest investigation attributes a broad far-infrared feature around 90 micron to calcite (CaCO3) and suggests the presence of carbonate particles in evolved stars. This may provide a challenge in the formation mechanism of carbonates in interstellar space, if this band assignment is correct.
Far-infrared spectroscopy of interstellar diffuse emission in star-forming regions also suggests the presence of a feature around 65 micron, which can be ascribed to diopside (CaMgSi2O6). If this assignment is correct, it will be the first detection of crystalline silicate dust in the interstellar space other than circumstellar regions.