Albedo distribution of main-belt asteroids based on IRAS, AKARI, and WISE

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Presently, the number of asteroids is known to be more than 630,000, and more than 90 % of asteroids with known orbital elements are classified as main-belt asteroids (MBAs). The spatial distribution of compositions among MBAs is of particular interest, because the main belt is the largest reservoir of asteroids in the solar system. Asteroids are thought to be the remnants of planetesimals formed in the early solar system, and allow us to study the formation and evolution of asteroids, origin of meteoroids and the near-Earth asteroids, as well as the formation of the solar system. Size and albedo are one of the most basic physical quantities of asteroid. Knowledge of size and albedo is essential in many aspects of asteroid research, such as the chemical composition and mineralogy, the size-frequency distribution of dynamical families and populations of asteroids, and the relationship between small bodies in the outer solar system and comets.

Several techniques have been developed to determine the size of asteroids; by direct imaging with the Hubble Space Telescope or large ground-based telescopes with adaptive optics, radar observations, speckle interferometry, stellar occultation combined with lightcurve inversion techniques, and spacecraft flyby / rendezvous / sample return. One of the most effective methods for measuring asteroid size and albedo indirectly is through the use of radiometry, which combines information of the thermal emission (infrared flux) and the reflected sunlight (absolute magnitude). This method can provide unique data for asteroid size and albedo. Using radiometric measurements, a large number of objects can be observed in a short period of time, providing coherent data for large populations of asteroids within the asteroid belt. Infrared observations can be made still better under ideal circumstances, from space. The first space-borne infrared telescope is the *Infrared Astronomical Satellite* (*IRAS*; [1]), launched in 1983 and performed a survey of the entire sky. To date, there are two other infrared astronomical satellites dedicated to all-sky survey: the Japanese infrared satellite *AKARI* [2], and the *Wide-field Infrared Survey Explorer* (*WISE*; [3]). Based on the all-sky survey data obtained by *IRAS*, *AKARI*, and *WISE*, the largest asteroid catalogs containing size and albedo data were constructed (e.g., [4–6] and their series of papers). The total number of asteroids with size and albedo measured by these three infrared surveyors is 138,285 (more than 20 % of currently known asteroids), and size and albedo measured by all three surveyors for 1,993 commonly detected asteroids are in good agreement (within ± 10 % for diameter and ± 22 % for albedo at 1σ deviation level) [7].

In addition, several outstanding works have provided the taxonomic classification of asteroids (e.g., [8–11]), based on ground-based spectroscopic observations in optical and near-infrared wavelengths. Along with these taxonomic classifications, size and albedo data also contribute to our understanding of asteroid compositions. In general, the albedo of C-type asteroids is considered as low and that of S-type asteroids is high (e.g., [12]). The relationship between taxonomic types and albedo is, however, complex and type determinations cannot be made on the basis of albedo values alone. Recently albedos of C- and S-type asteroids are found to vary widely, especially for sizes smaller than several tens of km [13].

In this talk, we present the details of a data compilation including size, albedo, and taxonomy of MBAs, and discuss the compositional distribution in the main belt regions. We found that the heliocentric distribution of the mean albedo of asteroids in each taxonomic type is found to be nearly flat, in spite of albedo transition process like space weathering. In the total distribution, on the other hand, the mean albedo value gradually decreases with increasing the semimajor axis, presumably due to the compositional mixing of taxonomic types.

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