Extension of Empirical Zodiacal Dust Cloud Model to the Near-Infrared and Visible Wavelengths for the SPHEREx Mission

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Among several empirical zodiacal dust cloud models, that of Kelsall et al. (1998), based on the COBE/DIRBE survey, is most popular owing to wide wavelength coverage (from 1.25 to 240 μm), well-calibrated observations, and implementation of cloud's small-scale structures. However, the original Kelsall model is limited at 10 photometric bands of COBE/DIRBE and simple inter- and extrapolations are not sufficient for spectral observations because features in the solar spectrum and interplanetary dust's reflectance are lost. SPHEREx (**S**pectro-**P**hotometer for the **H**istory of the Universe, **E**poch of **R**eionization, and Ices **Ex**plorer) is a NASA's medium-class mission to survey the whole sky at near-infrared wavelengths (0.75–5 μm) with low spectral resolution ($\lambda/\Delta\lambda \sim 40$–150) for about two years. We extended Kelsall's model for simulations of SPHEREx observations, focusing mainly on the scattering properties of interplanetary dust.

For the scattering phase function, we revisited inversion methods introduced in 1980s, taking into account the non-unity power-law exponent of dust radial distribution and the finite brightness integral. The reflectance of zodiacal light was synthesized by combining results from HST (Hubble Space Telescope), CIBER (Cosmic Infrared Background ExpeRiment), IRTS (InfraRed Telescope in Space), and AKARI to cover wavelengths from 0.27 to 4.6 μm. The visible part of reflectance curve is similar to that of C-type asteroids, while the near-infrared part up to 2.5 μm is to that of S- or Q-type, as pointed out in previous studies. Meantime, a bump-like feature around 3.5 μm is prominent at longer wavelengths. We tried to reproduce it with hot, small dust particles penetrating the Solar System from the Local Interstellar Cloud.