Measurement of Infrared Extragalactic Background Light Considering Interplanetary Dust Particles from Oort-cloud Comets

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Extragalactic background light (EBL) comprises the entire radiation from the reionization era to the present epoch and serves as a fundamental quantity to study the galaxy formation and exotic unknown objects. In the infrared (IR) wavelengths, it is reported that the residual emission derived by subtracting the foreground emissions, such as zodiacal light (ZL) and diffuse Galactic light from the total sky brightness exceeds the integrated galaxy light and the origin of the excess light is unclear[1]. It is possible that ZL brightness is underestimated in the removal analysis because the conventional ZL model[2] does not include isotropic component of interplanetary dust particles (IDP). The isotropic IDP can be supplied by Oort-cloud comets and is also suggested by some dynamical simulation of IDP evolution[3]. Assuming a simple isotropic dust cloud, we predict that the brightness of scattered light and thermal emission from it increases toward the regions of low solar elongation angle (ϵ). To study properties of the isotropic IDP, we analyze the weekly-averaged maps obtained with Diffuse Infrared Background Experiment (DIRBE) on board *Cosmic Background Explorer* (*COBE*), which covers $64^\circ < \epsilon < 124^\circ$ and near to mid IR wavelengths[4]. The result shows that the expected ϵ-dependence appears both in near and mid-IR wavelengths. In the mid-IR, we also find that the residual intensity increases toward the high-ϵ regions.

Density distribution of IDP as a function of heliocentric distance is thought to depend on their size in a recent model[5]. In the model, density of μm-sized grains simply decreases toward outer solar system, while that of several tens of μm-sized grains tends to increase toward outer solar system in the heliocentric distance of less than $\sim 70\,$AU. On the baisis of the density distribution, we calculate the intensity of scattered light and thermal emission, assuming the IDP compositions of astronomical silicate or carbonaceous grains. In the near-IR, the model calculation can be fitted to the observed ϵ-dependence. In the mid-IR, however, the model intensity is higher than that obtained in the mid-IR and cannot reproduce the feature observed in the high-ϵ regions. This might suggest that the mid-IR absorption efficiency of the grains is smaller than the assumed grain compositions and that the density of Oort-cloud comets increases toward the outer solar system more steeply than that of the recent model.

[1]Sano et al. 2015, ApJ, 811, 77
[2]Kelsall et al. 1998, ApJ, 508, 44
[3]Nesvorný et al. 2010, ApJ, 713, 816
[4]Hauser et al. 1998, ApJ, 508, 25
[5]Poppe et al. 2016, Icarus, 264, 369