Separation of the Near-Infrared Extragalactic Background Light and Scattered Sunlight by Interplanetary Dust

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Extragalactic background light (EBL) consists of the entire radiation from the reionization era to the present epoch. The EBL measurements are thus crucial in the study of star formation history of the universe and any unknown radiation process, such as particle decay of elementary particles. To derive the near-infrared EBL, foreground emissions including zodiacal light, integrated starlight, and diffuse Galactic light must be subtracted properly from the total sky brightness. Among these components, the zodiacal light, the scattered sunlight by interplanetary dust (IPD), is the dominant contributor to the sky brightness, indicating that the accuracy of the EBL intensity is sensitive to the evaluation of the IPD properties. Literatures have shown that the observed isotropic residual emission including the EBL are several times larger than the integrated light of galaxies[1,2,3] and it is difficult to attribute the entire intensity to other potential extragalactic sources, such as first stars[4] or intra halo light[5].

By compiling the previous results from optical to near-infrared, the spectrum of the residual emission is similar to that of the sunlight, indicating the presence of the scattered light component from an additional IPD[6]. Since such a component is expected to show nearly isotropic distribution around the sun, the residual emission exhibits the solar elongation dependence if it contains the scattered light component in the solar system. To confirm the presence of such dust, weekly-averaged all-sky maps obtained with Diffuse Infrared Background Experiment (DIRBE) on board *Cosmic Background Explorer* (*COBE*) are analyzed. The maps provide observed near-infrared sky brightness in various solar elongation angle, $64° - 124°$, which are suitable for the investigation of the angle dependence.

As a result of the analysis, the expected dependence on solar elongation angle is found in the residual emission at $1.25\,\mu$m, indicating that the residual emission consists of the additional IPD contribution. Compared with models of the isotropic IPD, it is possible that the most part of the residual emission are attributed to the IPD and the EBL intensity is closer to the integrated light of galaxies. This suggests that the extragalactic contribution other than normal galaxies is smaller than the previous prediction, though the origin of the EBL is still uncertain.

[1]Matsumoto et al. 2015, ApJ, 807, 57
[2]Sano et al. 2015, ApJ, 811, 77
[3]Matsuura et al. 2017, ApJ, 839, 7
[4]Cooray et al. 2012, ApJ, 756, 92
[5]Cooray et al. 2012, Nature, 490, 514
[6]Kawara et al. 2017, PASJ, 69, 31